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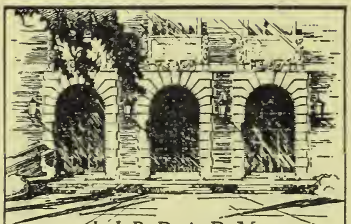

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JOURNAL OF THE AMERICAN STATISTICAL ASSOCIATION

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# STATISTICS IN THE SERVICE OF ECONOMICS[1]

By Carroll W. Doten, *Massachusetts Institute of Technology*

Not long ago I glanced through a book that I had read with very keen interest when it came from the press some twenty years ago. This was Richmond Mayo-Smith's *Statistics and Economics.* The thought occurred to me that it might be of interest to both economists and statisticians to review the progress that has been made in this field during the first two decades of the Twentieth Century.

You will recall that Mayo-Smith had great hopes concerning the service that statistics could perform for both sociology and economics. Have these hopes been justified by subsequent developments?

It is obvious that this is not the time or the place for one to present a thoroughgoing review or a detailed analysis of all of the work that has been done during the past twenty years in economic statistics. I shall therefore deal in a general way only with the changes that have occurred.

The subject under consideration naturally divides itself into two parts: What is economics, and what is service?

I shall not be foolhardy enough to attempt in the presence of so many experts to propound or defend a new definition of economics. Generally speaking, economics is the science which explains or attempts to explain economic life or economic phenomena; but there is not so clear-cut a distinction between the facts of economic life and the theories that are held with regard to them as there is in the natural sciences or even in some of the other sciences pertaining to man. For example, the motions of the stars have not been affected by astronomical theories. The properties of matter have not been changed by the developments in the science of physics, and chemical research has not altered the chemistry of nature. On the other hand, much of the economic life and structure of the world is the product of man's thought and conscious design.

---

[1] Presidential address read at the Eighty-third Annual Meeting of the American Statistical Association at Pittsburgh, Pa., December, 1921.

There have been attempts to trace the effects in economic life of special theories and of great leaders of economic thought, but too often the attention of the student has been given to the theories set forth in formal treatises. In other words, economics has been regarded as the writings of the economists. This is too narrow a view. Even at the present stage of the world's history, when thousands of college students are voluntarily or otherwise engaged in the study of the texts which the economists write for each other to read and when even business men sometimes read literature of this sort, the extent to which formal economics finds its way to the popular mind is very limited indeed.

Yet in spite of all this every man who is not an idiot is an economist. That is, he has an economic philosophy of some kind which not only determines his votes on great economic issues such as the tariff, taxation, government ownership, ship subsidies, and social insurance, and his attitude toward labor unionism, coöperation, profits sharing, and so on, but which also guides him in his personal efforts and contacts in doing business. As the greater part of a man's time is devoted to getting a living, so the greater part of his thought is taken up with economic problems.

The economics that prevails in the world today, in spite of the great increase in the tribe of professional economists in the one hundred and fifty years since Adam Smith, is still, as it always has been, the common garden kind which every man grows for himself, and not the highly developed hothouse exotic which we school-men have been so carefully cultivating. Naturally, the kind of economic theory which the individual develops for himself is largely the product of his environment, that is, his business and social contacts and associations. Thus we have trade union economics, farmers' economics, manufacturers' economics, bankers' economics, exporters' economics, and so on. From the school-man's point of view, each one of these species of economics is full of fallacies, and yet what have we been able to do about it?

We ridicule the "lump of labor" theory and proclaim that higher wages depend upon increased productivity without visible effect upon labor union policies or theories. We point out the true advantages of international trade, but the old mercantilist conception of a favorable balance payable in money everywhere holds sway. We say that a tax on economic rent cannot be shifted, and yet the little band of single taxers who under the leadership of Henry George embarked upon a crusade to popularize this doctrine is still a voice crying in the wilderness after forty years of devoted endeavor.

So we might go on and show in detail how the theories of the professional economists have failed to make a dent in the protective mental armor of the practical business men. It is true that the man on the street makes use of language that sounds like that of the economists and that he often proclaims his belief in the science by asserting that economic laws cannot be abrogated. When pressed to mention the laws he has in mind he usually falls back on "supply and demand."

Thus we find that economics is of two kinds—that of the small body of professional economists, and that of the great mass of the people—and both kinds split up into several varieties.

My second question was: What is meant by service? How can statistics serve economics?

The best service that statistics can perform is to bridge the gap between the two kinds of economics that I have mentioned. Statistics, on the one hand, can make some of the theories of the economists more intelligible to the man in the street, and, on the other hand, can be used to expose some of the fallacies in the theories of the man who cannot or will not study the textbooks. Statistics provides a common language that both can use. Statistics, to use a much overworked term, will "sell" economics to the business world.

It is not my purpose to attempt to show that every phase of economic theory is susceptible of statistical demonstration, though it is a fact that Mayo-Smith succeeded fairly well in giving a statistical content to every chapter in a formal treatise on economics.

Twenty years ago statistics, outside of governmental departments and some of the great insurance companies, occupied a limited field, and there were only two or three books in the English language dealing with its technique in a comprehensive manner. The membership of the American Statistical Association numbered less than three hundred after over sixty years of active existence, and not more than half of the members were engaged in any kind of statistical work. Today the membership is four times as large, and nearly all of those who have come in recently are active statisticians.

Thirteen years ago the policy of holding joint sessions with the American Economic and other associations was inaugurated. I have noted, as no doubt you have, that the programs of the American Economic Association have in the intervening years grown more and more statistical. In fact, at the meeting at Atlantic City last year it was difficult at times to determine by listening to the papers and the discussion whether one was in a session of that association or of the American Statistical Association. This same tendency may be noted, though to a somewhat less marked degree, in the *Economic Review*.

On the other hand, among the statisticians there have been marked changes going on. A rapidly increasing number of persons are engaged in business research. Now business research means essentially economic statistics. For several years most of the quarterly meetings and a considerable part of the program at each annual meeting of the American Statistical Association have been devoted to this kind of statistical work.

May I digress for a moment to point out the significance of the fact that this new field of endeavor is called *business research* and not *economic statistics?* This choice of terms was not due to a mere whim or fad, but is based upon a real conviction that both economics and statistics were handicaps in dealing with business men. Here is food for thought for both the economists and the statisticians, though the latter may find some little comfort in the fact that the term "business" supplanted "economics" long before "statistics" was abandoned in favor of "research."

It would be interesting to inquire into the causes of the low esteem in which economics and statistics were held until quite recently by business men, but it would take us too far afield. It is more important to consider present tendencies and to note that business men are gradually coming to have a greater appreciation of the services of economists and statisticians. This change has come about to a considerable extent in the last ten years, and it has been especially marked during and since the war.

Among the numerous causes for this change of attitude may be mentioned the facts that the business men of the present generation are more largely college men, that business is on a larger scale, and especially that the practical aspects of economics have been given greater emphasis in college curricula and in the writings of economists in recent years. In some institutions departments of economics have been practically transformed into schools of business, and in other institutions separate schools have been established; but everywhere banking, transportation, industrial relations, industrial organization and management, and other courses of this sort have been developed to a greater extent than those concerned with pure theory.

Coincident with these changes in the teaching of economics have been striking developments in the business world. Scientific management, production engineering, cost accounting, employment management and personnel work have opened up new fields of investigation, new professions, and a new literature, all of which are economic in their nature. They also make large use of statistics.

But large-scale business needs not only the services of these specialized economists and statisticians in its internal organization and management, but it needs also large and extended markets. This affords an opportunity for another set of practical economists and statisticians to develop the possibilities of advertising and salesmanship.

To meet the needs of business for statistical, economic, and industrial information a considerable number of service organizations and publications have come into existence. Whether these agencies are purely commercial or really scientific, in the best sense of that term, their growth and successful operation imply the existence of a pressing demand for the information which they can supply.

This is distinctively an age of associated effort. In practically every industry operators as well as operatives have some organization. Many of these organizations are nation-wide in their extent, like the Iron and Steel Institute, the National Cotton Manufacturers' Association, and the American Association of General Contractors. Then there are still more inclusive organizations, such as the National Manufacturers' Association. And so the list might be extended to include mining, farming, stock raising, commerce, and trade, all of which have participated in the great organization movement that has swept over the country in the last twenty years. Another somewhat older type of organization among business men, the chamber of commerce or board of trade, has shown remarkable vitality and wonderful growth in recent years, especially since the Chamber of Commerce of the United States was formed. Thus every city and, one might almost say, every village has its chamber or board, so that the whole country is covered by local, state, and national associations.

Nearly all of these organizations and associations have developed research bureaus or statistical departments of one sort or another. The same is true of the great banks, transportation companies, and other large commercial and industrial corporations. In carrying on the work of these bureaus and departments, economists have become closely associated with business men, to their mutual benefit. This has come about through volunteer work on committees and advisory boards, as well as through the employment in these enterprises of young economists taken from college faculties and of statisticians from government service and other fields of statistical work.

But more important than all of these undertakings in the line of associated effort was the Great War. In Washington and in all the industrial centers business men and economists worked side by side. Some were in uniform and some were "dollar-a-year" men. Some were in the greatly expanded personnel of the War and Navy Departments, but more were in newly created agencies like the War Trade Board, the Council of National Defense, the War Industries Board, the Fuel, the Food, and the Railroad Administrations, the Shipping

Board, and the War Labor Board. In all of these activities the technical training of the economist and statistician supplemented the practical knowledge of the business executive, and each came to know and esteem the other. Acquaintanceships and attachments were formed which will tend to increase coöperation and mutual understanding in the years to come.

Economists and statisticians may well feel a degree of satisfaction at the progress indicated in this very imperfect sketch. But let us not deceive ourselves. The battle is not yet won, and this is no time for complacency and inactivity. Under the stress of hard times business men are inclined to curtail expenses, and these new activities are naturally the first to be cut down or abandoned.

Unsatisfactory conditions exist in another quarter also. The federal government has been the great agency that has gathered most of the fundamental data used by economists and statisticians in the economic field. Government service has been also a splendid training school. But low salaries and the high cost of living in Washington have driven many out of government work, and the conditions are such that academic men cannot afford to make the sacrifices involved in accepting even temporary employment in the various bureaus.

It is probable that this situation cannot be changed while the demand for retrenchment and lower taxes is so insistent, but with the hoped-for lessening of the burden of armaments there will come the opportunity to press for larger appropriations in other lines. When this time comes Congress must be educated, as the business world has been, to see the importance of economic research.

In concluding, I cannot deny myself the privilege of making something like an appeal to the members of these two associations. I feel very keenly the necessity for continued and possibly aggressive activity. The two associations, through a joint committee appointed at the request of the Secretary of Commerce, have been coöperating for almost three years with the Director of the Census in the great task of the Fourteenth Decennial Census. This same committee has been made use of also by Secretary Hoover in certain other matters, especially in connection with the recent unemployment conference. The success of this arrangement has been such that I am convinced that it should be regarded as only the beginning of a much more extensive coöperation with governmental agencies.

We cannot accomplish much by passing resolutions at our annual meetings. We must have committees charged with the duty of following up all matters that we are interested in at Washington. These committees should be given the right to speak for the associations whenever they deem it necessary. In other words, we have as much right as the anti-saloon league, the labor unions, and the multitude of commercial organizations to seek to guide legislation and to promote more efficient administration.

But in the final analysis the obligation rests upon each of us individually to do his part. We must interest ourselves in what goes on in Washington. If we are to have the kind of information that we want, we must keep calling for it. Bureau and department officials need strong support in dealing with Congress. Get in touch with them personally or by correspondence. Praise them for their good work. Criticise their errors, if need be, but don't forget or neglect them. Let them know where to look for advice and help when they need it, and when they call for assistance try to respond promptly even if it means some personal sacrifice.

# ELASTICITY OF DEMAND AND FLEXIBILITY OF PRICES

BY HENRY LUDWELL MOORE, *Columbia University*

The effective quantitative treatment of the theory of demand began with Cournot. His work was both critical and constructive. As critic he showed nearly a century ago the confusion and sterility of the current literary discussion of the theory of demand, which has persisted in many places even to the present time. As creative economist he introduced the conception of demand as a mathematical function of price;[1] he gave a mathematical definition of what has subsequently been described as elasticity of demand; and he showed how many problems have different solutions according as the demand for the article in question is elastic or inelastic. His work is a foundation upon which statistical economists can build.

## COURNOT'S TREATMENT OF THE THEORY OF DEMAND

If $D=F(p)$ is the symbolic expression of the relation between the amount of commodity demanded, $D$, and the price per unit of commodity, $p$, then for many problems in economics it is of importance to know for what value of $p$ the product $pF(p)$ is a maximum. One of Cournot's concrete illustrations is that of a monopolist, owning a mineral spring where the cost of production is negligible, who wishes to know what price of the commodity will yield him the largest monopoly return. The mathematical condition is

$$\frac{d[pF(p)]}{dp}=F(p)+pF'(p)=0 \quad . \quad . \quad . \quad \text{(i)}.$$

But in order to carry this problem to a concrete solution one must know the empirical form of $D=F(p)$. Upon this statistical problem Cournot makes the following comment:

> We may admit that it is impossible to determine the function $F(p)$ empirically for each article, but it is by no means the case that the same obstacles prevent the approximate determination of the value of $p$ which satisfies equation (i) or which renders the product $pF(p)$ a maximum. *The construction of a table, where these values could be found, would be the work best calculated for preparing for the practical and rigorous solution of questions relating to the theory of wealth.*
>
> But even if it were impossible to obtain from statistics the value of $p$ which should render the product $pF(p)$ a maximum, it would be easy to learn, at least for all articles

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[1] He even had the idea of the demand for any one commodity being a function of the prices of all commodities. *Researches into the Mathematical Principles of the Theory of Wealth*, chap. xi, §74.

to which the attempt has been made to extend commercial statistics, whether current prices are above or below this value. Suppose that when the price becomes $p+\Delta p$, the annual consumption as shown by statistics . . . becomes $D-\Delta D$. According as

$$\frac{\Delta D}{\Delta p} < \text{ or } > \frac{D}{p},$$

the increase in price, $\Delta p$, will increase or diminish the product $pF(p)$; and, consequently, it will be known whether the two values $p$ and $p+\Delta p$ (assuming $\Delta p$ to be a small fraction of $p$) fall above or below the value which makes the product under consideration a maximum.[1]

Commercial statistics should therefore be required to separate articles of high economic importance into two categories, according as their current prices are above or below the value which makes a maximum of $pF(p)$. We shall see that *many economic problems have different solutions according as the article in question belongs to one or the other of these two categories.*[2]

Some of Cournot's statements have been italicized in the preceding quotation to indicate that in his opinion we must know the empirical laws of demand for commodities if we are to pass to the practical and rigorous solution of questions relating to the theory of wealth.[3]

The classification that Cournot makes between commodities according as $\frac{\Delta D}{\Delta p} < \text{ or } > \frac{D}{p}$ is essentially the classification which has subsequently been made between inelastic and elastic commodities, flexible and inflexible prices. To show this, let us pass from Cournot's symbols to those that have been rendered more familiar by Professor Marshall. In Professor Marshall's notation, $x$ stands for the amount demanded, and $y$, for the price per unit of commodity. If we substitute these symbols for those of Cournot we may write Cournot's statement in this way: According as $\frac{\Delta x}{\Delta y} <$ or $> \frac{x}{y}$, the increase in price, $\Delta y$, will increase or diminish the product $xy$.

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[1] The method of reaching the inequality discussed in the text may be indicated: The increase in price will increase the gross receipts if

(1) $(p+\Delta p)(D-\Delta D)>pD$, or

(2) $pD-p\cdot\Delta D+D\cdot\Delta p-\Delta p\cdot\Delta D>pD$, or

(3) $-p\cdot\Delta D+D\cdot\Delta p-\Delta p\cdot\Delta D>0$, or

(4) $\Delta D(p+\Delta p)<D\cdot\Delta p$, or

(5) $\frac{\Delta D}{\Delta p}<\frac{D}{p+\Delta p}$, or, when $\Delta p$ is small as compared with $p$,

(6) $\frac{\Delta D}{\Delta p}<\frac{D}{p}$.

[2] Cournot, *Researches into the Mathematical Principles of the Theory of Wealth*, pp. 53–54.

[3] Stanley Jevons seems to have had similar thoughts when he was engaged upon his unfinished *Principles of Economics*. He says on pp. 146–7: "It would be a matter of great importance, if it were practicable, to ascertain statistically the exact law of variation of price of the more important commodities. Assuming the demand to be constant, in the sense that there is a constant population of purchasers with fixed tastes, we should make the supply of the commodity—say wheat, sugar, tea—the variable, and then ascertain the changes of price, the variant. . . . As to the value of the laws, if we could determine them, there is little doubt. They would be practically important to merchants in judging of the probable effect of changes in supply; they would be theoretically important in giving reality to the theory of exchange, and allowing us actually to trace out the effects of all kinds of variations in trade.

"The difficulties in the way of such empirical determinations of laws are so formidable that I entertain little hope of successful investigations being made for many years to come."

So far Cournot carried the problem. But his statement may be easily simplified and its economic significance rendered much clearer. In Figure 1 we have the familiar graph of the law of demand, where $x$ = the amount of the commodity demanded; $y$ = the price per unit of commodity; and $DD'$ is the demand curve. Let the amount actually demanded be $x = OM$ and the resulting price be $y = MP$. Then, following Cournot's formula, it would be profitable to the monopolist to raise or lower his price according as

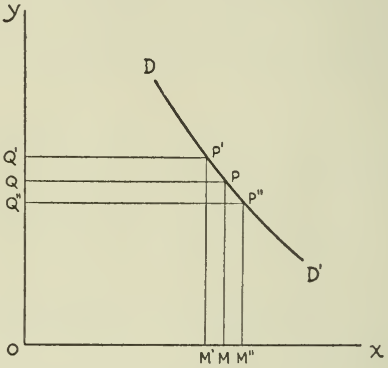

FIGURE 1

$$\frac{\Delta x}{\Delta y} < \text{ or } > \frac{x}{y} \quad . \quad . \quad . \quad \text{(ii)}.$$

The inequality (ii) may be divided through either by $\frac{x}{y}$ or by $\frac{\Delta x}{\Delta y}$. If we divide through by $\frac{x}{y}$, we get

$$\frac{\Delta x}{\Delta y} \cdot \frac{y}{x} < \text{ or } > 1 \quad . \quad . \quad . \quad \text{(iii)},$$

which is Professor Marshall's form of statement. He regards $\frac{\Delta x}{\Delta y} \cdot \frac{y}{x}$ as the measure of the elasticity of demand, and describes the demand for the commodity as inelastic or elastic according as $\frac{\Delta x}{\Delta y} \cdot \frac{y}{x}$ is less or greater than unity. If we call $\frac{dx}{dy} \cdot \frac{y}{x}$ the coefficient of elasticity of demand and indicate it by $\eta$, we may state Cournot's proposition as follows: The gross receipts of a monopolist will be increased or diminished by an increase in price according as $\eta <$ or $>1$, that is, according as the demand for the commodity is inelastic or elastic. This form of expression we have reached by dividing Cournot's inequality (ii) by $\frac{x}{y}$.

But we might equally well have divided it by $\frac{\Delta x}{\Delta y}$. If we do so, we shall have

$$1 < \text{ or } > \frac{x}{y} \cdot \frac{\Delta y}{\Delta x} \quad . \quad . \quad . \quad \text{(iv)}.$$

Let us now call $\frac{dy}{dx} \cdot \frac{x}{y}$ the coefficient of the flexibility of prices and indicate it by $\phi$. Cournot's proposition would then be as follows: The gross receipts of a monopolist will be increased or diminished by an increase in price according as $\phi >$ or $<1$, that is, according as prices are flexible or inflexible.

The relation between $\phi$ and $\eta$ is simply

$$\phi = \frac{1}{\eta} \quad . \quad . \quad . \quad \text{(v)}.$$

If we can find statistically either $\phi$ or $\eta$, equation (v) will enable us to find the other.

### TYPICAL EQUATION TO THE LAW OF DEMAND

In a later section of this paper a method will be presented by means of which the empirical laws of demand may be ascertained, but before passing to the statistical precedure it is desirable to know what the typical forms of the demand curve must be. Here we follow a hint that is given by Cournot:

> If we cease considering the question from an exclusively abstract standpoint, it will be instantly recognized how improbable it is that the function $pF(p)$ should pass through several intermediate maxima or minima inside of the limits between which the value of $p$ can vary; and as it is unnecessary to consider maxima which fall beyond these limits, if any such exist, all problems are the same as if the function $pF(p)$ only admitted a single maximum. The essential question is always whether, for the extent of the limits of oscillation of $p$, the function $pF(p)$ is increasing or decreasing for increasing values of $p$.[1]

The purport of Cournot's reasoning we may examine a little more closely. Let the law of demand be $y = F(x)$ where $y$ is the price per unit of commodity and $x$ is the amount of the commodity demanded at price $y$. The maximum gross receipts will be obtained when $xF(x)$ is a maximum. According to Cournot, practical experience teaches that as a rule $y$ varies only within comparatively narrow limits and that, consequently, for practical purposes we may assume that at only one value of $x$ is $xF(x)$ a maximum. We know, however, that when $xF(x)$ reaches a maximum both the elasticity of demand and the flexibility of prices are equal to unity[1] and that before the maximum is reached demand is elastic and prices are inflexible, while just after the point of the maximum the demand is inelastic and prices are flexible. This fact gives the clue to the method of deriving the typical equation to the demand curve.

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[1] Cournot, *op. cit.*, p. 55.

The simplest method of expressing symbolically the Cournot hypothesis is to regard either the elasticity of demand or the flexibility of prices as a linear function of the amount demanded. In case of the flexibility of prices we may write the assumption as follows:

$$\phi = \alpha + \beta x \quad . \quad . \quad . \quad \text{(vi)}.$$

But according to the definition of flexibility of prices, $\phi = \frac{dy}{dx} \cdot \frac{x}{y}$ which may be written $\phi = \frac{dy}{y} \Big/ \frac{dx}{x}$. We may, therefore, put equation (vi) in this form:

$$\frac{dy}{y} \Big/ \frac{dx}{x} = \alpha + \beta x, \text{ or}$$

$$\frac{dy}{y} = \alpha \frac{dx}{x} + \beta dx.$$

Integrating, we get

$$\log_e y = \alpha \log_e x + \beta x + \log_e A.$$

Or, passing from logarithms to absolute numbers,

$$y = Ax^{\alpha} e^{\beta x} \quad . \quad . \quad . \quad \text{(vii)}.$$

Equation (vii) may be called the typical equation to the law of demand.

The typical equation to the law of demand has been reached by giving an accurate symbolic definition of flexibility of prices and then following out the implication of Cournot's discussion as to the nature of the law of demand with respect to the variation of the flexibility of prices. A comparison of equation (vi) and (vii) shows that if the typical equation $y = Ax^{\alpha} e^{\beta x}$ is ascertained empirically from statistical data we may

[1] The proof is quite simple. If $y = F(x)$, then $xF(x)$ is a maximum when $\frac{d[xF(x)]}{dx} = 0$, that is, when $F(x) + xF'(x) = 0$, or when $y + x\frac{dy}{dx} = 0$. This last condition may be put in the form $\frac{x}{y} \cdot \frac{dy}{dx} = -1$. But $\frac{x}{y} \cdot \frac{dy}{dx} = \phi$ and by equation (v), $\phi = \frac{1}{\eta}$.

write at once the equation to the flexibility of prices $\phi=\alpha+\beta x$, because the two constants $\alpha$ and $\beta$ in $\phi=\alpha+\beta x$ are explicitly given in $y=Ax^{\alpha}e^{\beta x}$.

Equation (vii) was reached on the assumption that the flexibility of prices is a simple linear function of $x$. We may make the hypothesis a little more complex by assuming that

$$\phi=\alpha+\beta x+\gamma x^2 \quad . \quad . \quad . \quad \text{(viii)}.$$

Then, since by definition $\phi=\dfrac{dy}{y}\bigg/\dfrac{dx}{x}$, we have

$$\frac{dy}{y}=\alpha\frac{dx}{x}+\beta dx+\gamma x dx.$$

Integrating, we get

$$\log_e y=\alpha \log_e x+\beta x+\frac{\gamma x^2}{2}+\log_e A,$$

or, passing from logarithms to absolute quantities,

$$y=Ax^{\alpha}e^{\beta x+\frac{\gamma x^2}{2}} \quad . \quad . \quad . \quad \text{(ix)}.$$

This gives the typical equation to the law of demand in a slightly more complex form.

### PROCEDURE IN THE STATISTICAL DERIVATION OF THE LAW OF DEMAND

The *Yearbook of the Department of Agriculture* gives statistics of the production and of the December farm prices of agricultural commodities throughout a long interval. The data referring to the production and prices of potatoes from 1881 to 1913 will be used to illustrate the derivation of the empirical law of demand for potatoes and of the law of the variation of the flexibility of prices or of the elasticity of demand.

In Figure 2 the secular trend of the production of potatoes from 1881

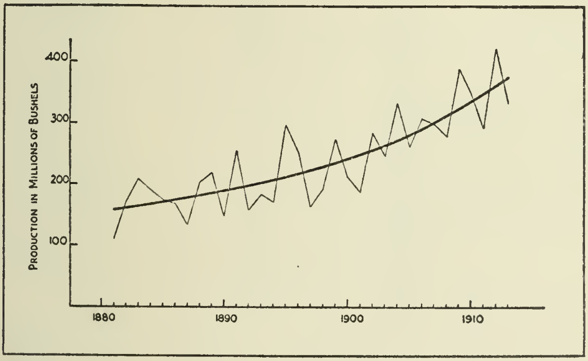

Figure 2. The Secular Trend in the Production of Potatoes in the United States. $y=222.3+5.711t+.1758t^2+.004363t^3$, origin at 1897

to 1913 is graphed, and a similar curve for the secular trend of the prices of potatoes might be given. The equation to the trend of production is printed on Figure 2; the equation to the trend of prices is, with origin at 1897,

$$y=48.86+.775\,t+.0443\,t^2-.002935\,t^3.$$

After the trends of the two series of figures—production and prices—have been computed, the next step in the problem is to express the observed values of the quantities as ratios to the corresponding respective trends. The ratios relating to production and prices we shall refer to, respectively, as production ratios and price ratios. In Table I these ratios are tabulated.

The correlation of the price ratios and the production ratios of potatoes is $r=-.84$, which is sufficient evidence of a very high relation between the two series. Our problem now is to find for any one year the relation between the variation of the amount of the commodity

TABLE I

THE ANNUAL PRODUCTION OF POTATOES AND THEIR DECEMBER FARM PRICES IN THE UNITED STATES. PRODUCTION RATIOS AND PRICE RATIOS

| Year | Production: millions of bushels $x$ | Price: cents per bushel $y$ | Production ratio $X$ | Price ratio $Y$ |
|---|---|---|---|---|
| 1881 | 109 | 91.0 | .690 | 1.52 |
| 82 | 171 | 55.7 | 1.062 | .97 |
| 83 | 208 | 42.2 | 1.261 | .77 |
| 84 | 191 | 39.6 | 1.137 | .74 |
| 85 | 175 | 44.7 | 1.023 | .88 |
| 86 | 168 | 46.7 | .960 | .94 |
| 87 | 134 | 68.2 | .753 | 1.41 |
| 88 | 202 | 40.2 | 1.110 | .85 |
| 89 | 218 | 35.4 | 1.172 | .75 |
| 1890 | 148 | 75.8 | .783 | 1.63 |
| 91 | 254 | 35.8 | 1.316 | .76 |
| 92 | 157 | 66.1 | .793 | 1.41 |
| 93 | 183 | 59.4 | .906 | 1.27 |
| 94 | 171 | 53.6 | .826 | 1.13 |
| 95 | 297 | 26.6 | 1.401 | .56 |
| 96 | 252 | 28.6 | 1.161 | .59 |
| 97 | 164 | 54.7 | .739 | 1.12 |
| 98 | 192 | 41.4 | .842 | .84 |
| 99 | 273 | 39.0 | 1.162 | .77 |
| 1900 | 211 | 43.1 | .876 | .84 |
| 01 | 188 | 76.7 | .758 | 1.46 |
| 02 | 285 | 47.1 | 1.113 | .88 |
| 03 | 247 | 61.4 | .936 | 1.13 |
| 04 | 333 | 45.3 | 1.224 | .82 |
| 05 | 261 | 61.7 | .929 | 1.09 |
| 06 | 308 | 51.1 | 1.058 | .89 |
| 07 | 298 | 61.8 | .990 | 1.06 |
| 08 | 279 | 70.6 | .894 | 1.21 |
| 09 | 389 | 54.1 | 1.201 | .90 |
| 1910 | 349 | 55.7 | 1.039 | .93 |
| 11 | 293 | 79.9 | .840 | 1.33 |
| 12 | 421 | 50.5 | 1.163 | .83 |
| 13 | 332 | 68.7 | .883 | 1.14 |
| Total |  |  | 33.001 | 33.42 |
| Mean |  |  | 1.00 | 1.01 |

produced and the corresponding most probable price, and we have to solve the problem from our knowledge of the relation between production ratios and price ratios throughout an interval of time.

Let $X$ represent the production ratio and $Y$ the price ratio, and let us assume that the typical equation connecting $X$ and $Y$ is

$$Y=A'X^{\alpha'}e^{\beta'X} \quad . \quad . \quad . \quad \text{(x)}.$$

The reason for assuming this type of equation will appear at the end of the article. Before proceeding to fit equation (x) to the data, we may effect a simplification by observing that the value of $A'$ is already known. When $X$, the price ratio, is 1.0, the production ratio is likewise 1.0, and if these values[1] are substituted in (x), the value of $A'$ is found to be $e^{-\beta'}$,

and consequently (x) becomes

$$Y=X^{\alpha'}e^{\beta'(X-1)} \quad . \quad . \quad . \quad \text{(xi)}.$$

To fit equation (xi) to the observations, let us first take logarithms of both sides of the equation. We have

$$\log Y=\alpha' \log X+\beta'(X-1)\log e \quad . \quad . \quad . \quad \text{(xii)}.$$

If the method of least squares is used to fit equation (xii) to the observations, we have as the observation equations

$$[\log Y_1-\alpha' \log X_1-\beta'(X_1-1)\log e]^2=v^2_1$$

$$. \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad .$$

$$[\log Y_N-\alpha' \log X_N-\beta'(X_N-1)\log e]^2=v^2_N.$$

The sum of the squares of the errors, $\Sigma(v^2)$ is a function of $\alpha'$ and $\beta'$, and in order to find their most probable values, we have the normal equations

$$\frac{\partial\Sigma(v^2)}{\partial\alpha'}=\Sigma(\log Y\log X)-\alpha'\Sigma(\log X)^2-\\ .4343\,\beta'\Sigma(X\log X)+.4343\,\beta'\Sigma(\log X)=0;$$

$$\frac{\partial\Sigma(v^2)}{\partial\beta'}=\Sigma(X\log Y)-\Sigma(\log Y)-\alpha'\Sigma(X\log X)+\alpha'\Sigma(\log X)\\ -.4343\,\beta'\Sigma(X^2)+.8686\,\beta'\Sigma(X)-.4343\,N\beta'=0.$$

By means of these two normal equations the most probable values of $\alpha'$ and $\beta'$ may be determined from the observations. When the calculation is carried out for the production ratios and price ratios of potatoes, the equation connecting the two is found to be

$$Y=X^{.143}e^{-1.376(X-1)} \quad . \quad . \quad . \quad \text{(xiii)}.$$

Its graph is drawn in Figure 3.

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[1] In the case of potatoes the mean values of $X,Y$ are, practically, 1.0. See Table I. There may be cases where it would be better not to use this hypothesis but to determine $A'$ from the observations. This could be done by following the same method as that described in the text.

Equation (xiii) gives the relation between the price ratios and the production ratios for the interval 1881–1913. It may be called the law of demand for potatoes in the ratio form. A simple transformation will make possible the next step, which is the derivation of the law of demand for any one year in terms of absolute quantities. Let $T_x$ be the trend of production for any given year and $T_y$ be the corresponding trend of prices for the same year. According to the definition of $X$ and $Y$ as they appear in equation (xiii), $X = \frac{x}{T_x}$; $Y = \frac{y}{T_y}$. By making these substitutions in (xiii), the law of demand for potatoes in the absolute form becomes

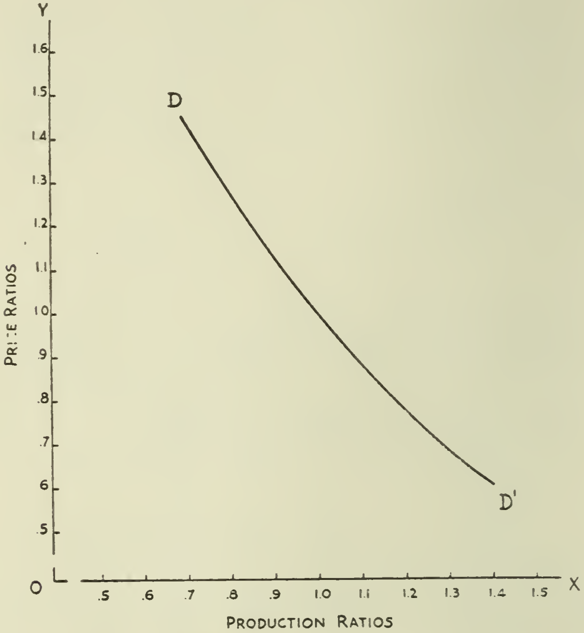

FIGURE 3. THE LAW OF DEMAND FOR POTATOES. (RATIO FORM.)
$Y = X^{.143} e^{-1.376\,(X-1)}$

$$y = \frac{T_y}{T_x^{.143}} e^{1.376} x^{.143} e^{-\frac{1.376}{T_x}x} \quad . \quad . \quad . \quad \text{(xiv)},$$

$$= A x^{.143} e^{-\frac{1.376}{T_x}x}, \text{ where } A = \frac{T_y}{T_x^{.143}} e^{1.376}.$$

If, for example, the law of demand for potatoes in 1913 is to be ascertained, find the trend of prices for 1913, $T_y$, and the trend of production for 1913, $T_x$, and substitute these values in (xiv). The values of

$T_y$, $T_x$ may be obtained for any one year from the equations to the trends which have already been given.[1]

After the law of demand, in the absolute form, has been ascertained it is a simple matter to find the law of the variation of the flexibility of prices, or of the elasticity of demand. Since $\phi$, the flexibility of prices, is by definition equal to $\frac{dy}{y}\Big/\frac{dx}{x}=\frac{x}{y}\cdot\frac{dy}{dx}$, all that is needed is to find this value from equation (xiv). But this process is not necessary, for it may be shown that the equation descriptive of $\phi$ may be written immediately from equation (xiii), that is to say, the equation descriptive of the flexibility of prices (or of the elasticity of demand) may be inferred immediately from the law of demand in the ratio form (equation xiii). In this particular case $\phi=.143-1.376\ X$, and the manner in which the constants are obtained from (xiii) is obvious. Later on a general proof will be given of the legitimacy of deriving the equation to the flexibility of prices in this way. In the meantime we shall examine a little more in detail the information given by the equation $\phi=.143-1.376\ X$. Its graph is traced in Figure 4, and we are able to see at a

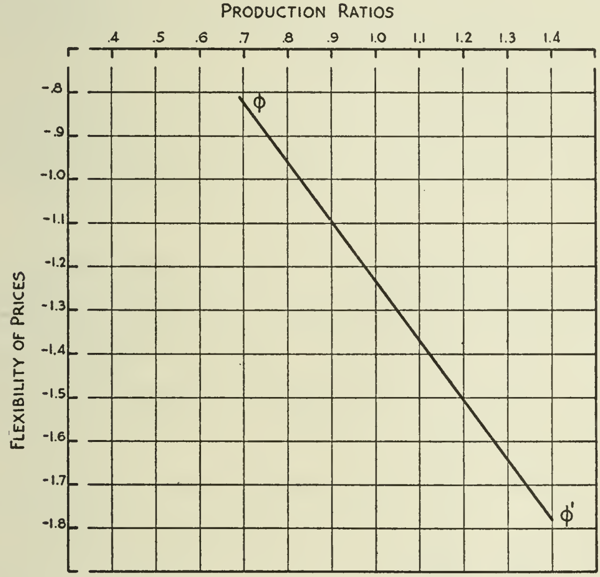

FIGURE 4. THE FLEXIBILITY OF THE PRICES OF POTATOES.
$\phi=.143-1.376\ X$

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[1] The objection may be made that since the trends are described by parabolas of the type, $y=a+bt+ct^2+dt^3$, if we extrapolate for many years beyond the observations the curves may give impossible results. But the subject of the present article is not what will occur many years beyond the limits of observation. To a similar objection on the part of an unfriendly critic Pareto once replied: *Quando vi si dà una formula valevole entro certi limiti, chi vi insegna ad applicarla fuori di quei limiti?*

glance how the flexibility of prices varies from point to point in the demand curve. The maximum value of $\phi$ is $-.81$ and its minimum value is $-1.78$. Consequently, since $\eta$, the elasticity of demand, is related to $\phi$ through the equation $\eta=\frac{1}{\phi}$, we know that, in the case of potatoes, for this particular market,[1] the maximum value of $\eta$ is $-\frac{1}{1.78}$, and its minimum value is $-\frac{1}{.81}$.

This method of calculating $\phi$ and $\eta$ ought to throw considerable light upon a perplexing statement by Professor Marshall in his classic chapter on "The Elasticity of Wants":

> The elasticity of demand is great for high prices, and great, or at least considerable for medium prices; but it declines as the price falls; and gradually fades away if the fall goes so far that satiety level is reached. This rule appears to hold with regard to nearly all commodities and with regard to the demand of every class.[2]

I have called this statement perplexing because we have had no means of deriving empirical laws of demand and because it has been impossible to picture concretely what is meant by elasticity of demand being "great" or "considerable." One knows when a coefficient of correlation is "great" or "considerable," but what is a "great" or a "considerable" elasticity of demand? The graph of the values of $\phi$ or $\eta$ gives a definite idea.

Another matter upon which the equation $\phi=\alpha'+\beta'X$, or, in this particular case, $\phi=.143-1.376\,X$, throws light is the problem of ascertaining for what value of $x$, the gross receipts, $xy$ are a maximum. We know that when the gross receipts are a maximum, the flexibility of prices, or the elasticity of demand, is equal to $-1$. All that is necessary to find the proper value of $x$ is to take the following two steps. First place $\phi=-1$ in the equation $\phi=\alpha'+\beta'X$, or, in this particular case, $\phi=.143-1.376\,X$ and solve for $X$. This gives the solution in terms of ratio of production to trend of production. In the particular case before us $X=.83$; that is to say, according to the experience from 1881 to 1913, the gross receipts of the farmer from the sale of potatoes reached a maximum when the production fell 17 per cent short of the trend of production. If it is now desired to pass from percentages to absolute quantities, we may take the next step and put $X=\frac{x}{T_x}=.83$ and solve for $x$, which will give the absolute number of bushels that will probably give the maximum return in the year for which $T_x$ is the trend of production.

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[1] It is always necessary to specify the market for which the empirical laws of demand apply. The values of $\phi$ and $\eta$ vary from market to market.

[2] Marshall, *Principles of Economics*, 4th edit., p. 178.

We return now to the method of deriving the equation descriptive of $\phi$, the flexibility of prices. In the earlier part of this paper we assumed that the typical equation descriptive of the relation between price ratios and production ratios was $Y=A'X^{\alpha'}e^{\beta'}X$ (see equation (x)). We proved that the typical equation in the absolute form was $y=Ax^{\alpha}e^{\beta x}$ (see equation (vii)), on the assumption that $\phi=\alpha+\beta x$. We shall now show that $\alpha=\alpha'$ and $\beta=\frac{\beta'}{T_x}$, and consequently, when the statistical work has been carried as far as the derivation of the law of demand in the ratio form $Y=A'X^{\alpha'}e^{\beta'X}$, we can write immediately the equation to $\phi$, namely,

$$\phi=\alpha'+\frac{\beta'}{T_x}x=\alpha'+\beta'X.$$

In the equation $Y=A'X^{\alpha'}e^{\beta'X}$ put $Y=\frac{y}{T_y}$, $X=\frac{x}{T_x}$. Then,

$$\frac{y}{T_y}=A'\left(\frac{x}{T_x}\right)^{\alpha'}e^{\beta'\left(\frac{x}{T_x}\right)}, \text{ consequently, } y=A'\frac{T_y}{T_x{}^{\alpha'}}x^{\alpha'}e^{\frac{\beta'}{T_x}x}$$

$$=Ax^{\alpha'}e^{\frac{\beta'}{T_x}x}, \text{ where } A=A'\frac{T_y}{T_x{}^{\alpha'}}.$$

Taking logarithms of both sides of $y=Ax^{\alpha'}e^{\frac{\beta'}{T_x}x}$,

$$\log y=\log A+\alpha'\log x+\frac{\beta'}{T_x}x,$$

and then differentiating we get

$$\frac{1}{y}\frac{dy}{dx}=\frac{\alpha'}{x}+\frac{\beta'}{T_x}, \text{ whence, } \frac{x}{y}\frac{dy}{dx}=\alpha'+\frac{\beta'}{T_x}x.$$

But $\frac{x}{y}\frac{dy}{dx}=\phi$ according to definition, and we may write

$$\phi=\alpha'+\frac{\beta'}{T_x}x=\alpha'+\beta'X.$$

The equation description of the flexibility of prices may, therefore, be written immediately from the law of demand in the ratio form

$$Y=A'X^{\alpha'}e^{\beta'X}.$$

# MANAGEMENT AND THE BUSINESS CYCLE[1]

By Henry S. Dennison

## FOREWORD

Although there have always been cycles of some sort in every phase of human activity, the business cycle as we now know it is of comparatively recent origin. It is not very long since almost all manufactured goods were made to order by individual craftsmen and delivered by them direct to the ultimate consumers. Supply and demand, therefore, were in close touch with each other and there was little excuse or reason for any maladjustment between the two. The only cycles they could have were those due to meteorological or political causes, or to the discovery of new lands and new mines. The rise of modern industry with its indirect methods of distribution has removed the original producer very far from the ultimate consumer. This makes it necessary for the producer to gage the requirements of the consumer considerably in advance of the actual call for the goods. Supply, therefore, is regulated not by actual demand but by what the supplier thinks that demand will be. If the supplier's prediction were always correct, there might be no such thing as our present business cycle. One trouble is that at the critical moment the producer is misled by appearances and produces most actively just when the consumer's demand is about to fall off.

## SUPPLY AND DEMAND

Chart No. 1 illustrates the point in question. I have not tried to draw it with any pretense at scientific accuracy. I hope that it will prove suggestive enough to tease some of you statisticians and economists to try that. The point it ought to bring out is that there are three principal factors which enter into the effective demand for any article or group of articles. These are needs or requirements, financial resources, and price expectation.

The beaded lines in the two upper sections of the charts represent the purchaser's price expectations. Take particular note that they do not represent what prices are, but show the extent to which business is affected by the purchaser's opinion as to what they are going to be. The heavy straight line represents a neutral price expectation. When

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[1] Read at the Eighty-third Annual Meeting of the American Statistical Association at Pittsburgh, Pa., December, 1921.

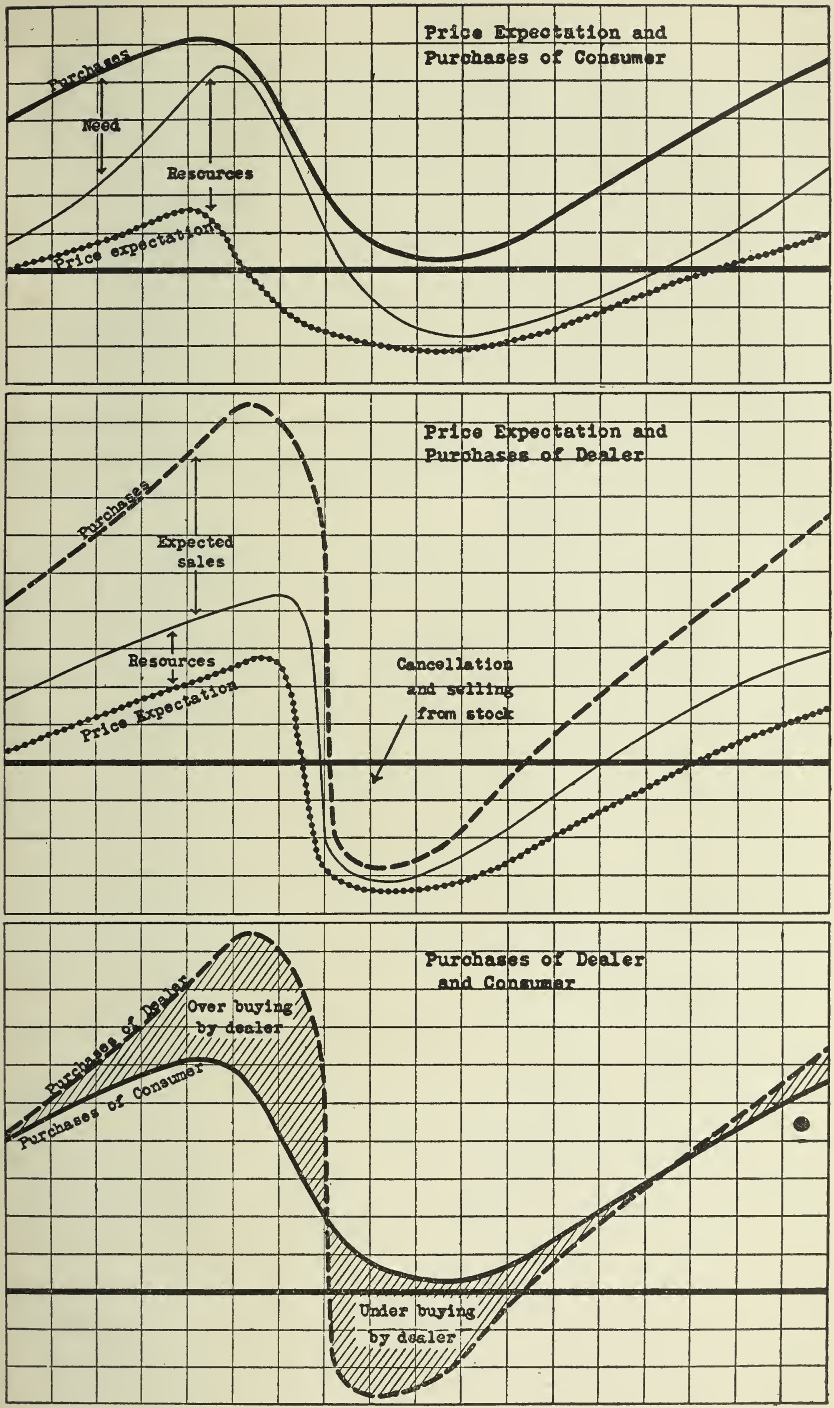

Chart 1. Some Forces Controlling Supply and Demand

the beaded line is above this line, the buyer thinks prices are going up, and when it is below, he thinks prices are coming down. The farther it is above or below the neutral line, the greater the expectation is intensified. When the price expectation line turns downward it indicates not an expectation of lower prices, but merely a weakening in the belief that prices are going up. There is no change from a higher to a lower price expectation until the price line actually crosses the neutral line. Similarly, when the curve turns upward it represents merely a weakening in the belief that prices are still going down. The appearance of a belief in higher prices is not indicated until the price expectation curve again rises above the neutral line.

The heavy black line represents purchases, and the two spaces between the heavy line and the beaded line represent the buyer's needs and the buyer's resources. In the case of the dealer, his sales expectation is the basis of his needs.

Both the consumer and the dealer buy relatively more when they think prices are going up, and less when they think prices are going down. In the same way, the consumer buys more when weekly earnings are high and less when factories are shut down and he has less to spend. The dealer's resources probably have little effect on his buying until he reaches his credit limits or until the crash comes and wipes out his resources entirely. Then his lack of resources helps to limit his purchases until he gets back on his feet again.

In superimposing the consumers' and dealers' charts I have indicated a lag between the movement of the two. This lag, in my opinion, was an important factor in the recent depression. The superimposing of the two lines illustrates what I believe to be the fact, that on the upgrade of the cycle, taking the country as a whole, including the ultimate consumers, we were stocking up with goods, whereas on the down-grade we were drawing from stocks.

The great need of modern industry and commerce is for intelligent direction which looks well beyond the feeling of the moment. We must help the business man to form the habit of planning and budgeting, which processes force careful attention upon the future. As planning and budgeting become habitual, unbridled guessing will be displaced by more careful estimates—by guesses guided by available facts. The manufacturer has no more important problem than that of forecasting the demand for his products. He cannot afford to be misled by outward appearances, or by such phrases as "the shelves of the country are bare," or "the shelves of the country are glutted." His greatest need is for timely statistics, well presented and widely distributed.

The business man must abolish the fear of being called a pessimist and the fear of affecting the country adversely through proper pessimism. The time to be a bull on the United States is not when everybody else is a bull, because at such times the country is surfeited with bulls. The time when the country needs bulls is when everybody else is a bear. It is no credit to be optimistic when the country is suffering from overproduction and overexpansion.

### REGULATING PURCHASES

The purchasing agent must be interested in cycles for two reasons: first, in order to gage the purchasing requirements, and second, in order to gage prices. For his purchase requirements he will have to depend largely on the planning department, but within certain limits he will vary his actual purchases according to existing prices.

Before the war we started to try out an interesting experiment in our purchasing department. Unfortunately, the unusual conditions of the war-time period interfered somewhat with the development and extension of our plan, but now we are getting it under way again. Briefly, our idea is this: We have figured out roughly the maximum and minimum inventories of each important raw material which we are willing to carry at different periods of the cycle. Then we have charted over a long period the prices of the principal commodities that we purchase, and through this we have drawn a line showing the secular trend. (See Chart 2.) Approximately parallel to and a certain dis-

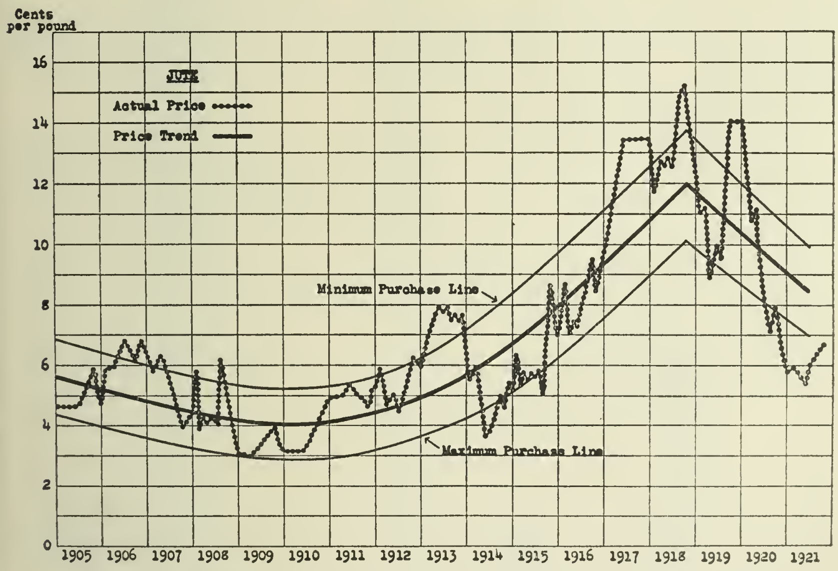

Chart 2. Use of the Price Trend as a Guide to Purchasing

tance above and below this line of secular trend, we have drawn what we call our minimum and maximum purchase lines. Then we vary our actual purchases according to the position of actual prices relative to these three lines. The minimum purchase line represents the smallest amount we dare carry for current needs, and the maximum purchase line represents the most that we consider it wise to invest in inventories. Suppose, for instance, that on a certain material our standard quantity to order is six weeks' supply. If prices are below the line of secular trend we may buy up to twelve weeks' supply, but if prices are above the line of secular trend we may buy not more than two weeks' supply. We make no attempt to gage the actual turning point, because we believe that it is impossible to hit it exactly. Most purchasing agents who wait for the actual turning point buy too late or too much.

I do not mean to imply that our purchasing is a purely automatic affair, but merely that we have found it wise to use certain mechanical guides. The one great temptation always before a purchasing agent is to buy far beyond estimated needs on a rising market. Each day the problem of how much to buy comes up on some individual commodity, and at the time there seems to be every reason for buying up for a long time ahead. Hence, unless some guiding rules are followed, the cumulative result is likely to be such that in emergencies the management will find that it has too much money tied up in inventories.

I doubt if the American business structure has yet gone far enough in divorcing manufacturing and merchandising from speculation. It is quite as dangerous to speculate in goods as to speculate in stocks. Merchandise cannot be sold as quickly as stocks, for the facilities of the stock exchanges are lacking.

The earnings of thousands of employees and the savings of many stockholders depend upon the continuous operation of manufacturing industries. It is a doubtful policy for the manufacturer to jeopardize the interests of so many persons for purposes of speculation. If a number of persons wish to take big risks they organize a speculating corporation, the stockholders of which are willing to take this risk on the chance of getting higher returns. The directors of a concern already burdened with all the problems of production and distribution have not the time to give sufficient study to the course of raw material prices. That is the business of the broker who devotes his entire time to the study of the market. The manufacturing industries should look for their recompense to the somewhat steadier profits that result from the skill with which the functions of manufacturing and merchandising are performed. This particular process of closer functionalization can be carried out more widely with good results.

### IMPENDING INVENTORIES

The purchasing agent must watch very closely the merchandise on order and en route as well as goods on hand, and the management and the bankers would be well advised to do the same. One important aggravation to the overstock during a slump lies in goods on order, *i. e.*, the impending inventory.

I have tried to make this point clear by means of Chart 3. This chart shows how a ten months' supply before the break in buying becomes a twenty months' supply after the rate of purchasing has been cut in half. But this is not all. During the peak of prosperity the suppliers were tied up with long delivery time, and it was necessary to place the order early so as to be sure of getting the goods. Railroads were all congested with undelivered freight, and the purchasing agent

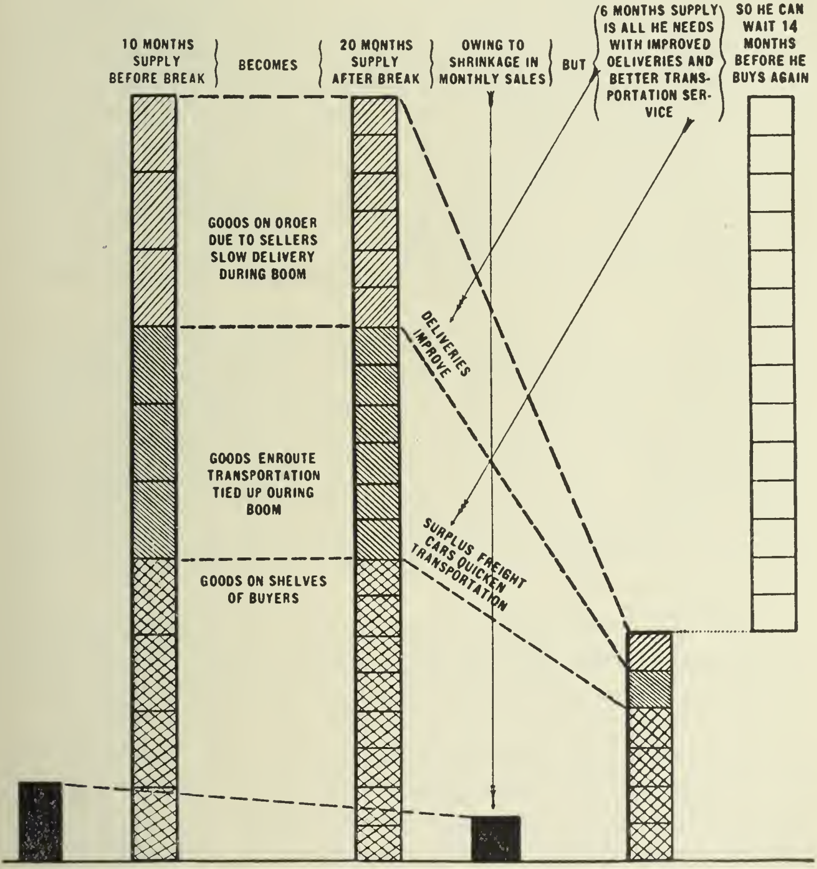
10 MONTHS SUPPLY BEFORE BREAK
BECOMES
20 MONTHS SUPPLY AFTER BREAK
OWING TO SHRINKAGE IN MONTHLY SALES
BUT
6 MONTHS SUPPLY IS ALL HE NEEDS WITH IMPROVED DELIVERIES AND BETTER TRANSPORTATION SERVICE
SO HE CAN WAIT 14 MONTHS BEFORE HE BUYS AGAIN
GOODS ON ORDER DUE TO SELLERS SLOW DELIVERY DURING BOOM
GOODS ENROUTE TRANSPORTATION TIED UP DURING BOOM
GOODS ON SHELVES OF BUYERS
DELIVERIES IMPROVE
SURPLUS FREIGHT CARS QUICKEN TRANSPORTATION

Chart 3. Why the Merchant Stops Buying

had to make long allowances on this account. But as business fell off the suppliers' deliveries improved and the increase in surplus freight cars made it possible to move goods more quickly. Hence a much shorter allowance of time becomes necessary. So he is left with twenty months' supply on hand and on order, while all that he needs now is six months' supply. It will be fourteen months before he needs to buy again. We must count not only stocks on our shelves but also stocks on order and en route. Such expressions as "the shelves are empty," and "the shelves are full," are relative only, and the situation is quickly changed when the volume of business declines.

### FIXED INVESTMENT

As the business cycle advances the heads of a corporation should scrutinize more and more carefully each project put before them by the engineering staff. They will find that even if the projects are completed as to planning, many of them can be postponed as to execution with profit to the company and to the community as well. In the boom before 1873, Andrew Carnegie, when asked by Mr. Farquhar why he did not build more furnaces, said that it would be cheaper to wait and buy plants that other men were building. He did not exactly foresee the panic that was to come, but he knew that the steel industry was being expanded at a more rapid pace than the market could assimilate, and it was therefore evident to him that a number of firms were doomed to failure.

It takes time to draw up building plans and discuss them, and after construction is started it takes a long time to finish the buildings and fill them with machinery. Hence the business man cannot afford to wait until his present facilities are overtaxed before he begins to consider expansion. Those who do wait are likely to find their added capacity becoming available at just the time when they ought to be curtailing their output, or after they have already done so. They build fixed assets when they cost the most and finish them when they are needed least.

The only way to avoid this is to study the long-range trend of your business; find out the rate of normal growth, and build for it. In our company we have charted our line of growth for different facilities over a period of twenty years or more, and on this basis we estimate our future requirements during the cycle as a whole. (See Chart 4.) When building and machinery prices are below the secular trend, we build a little more than up to the normal line, and when they are above, we build less or stop building entirely. We do not try to build at the exact bottom of the market any more than we try to purchase raw materials at that time. It would be even harder to hit the exact bottom in building than it is in the case of merchandise or raw materials.

Of course if we have not the money during depression we cannot build; but the desire to have the money on hand is a strong restraint during booms, and good planning will usually make it possible.

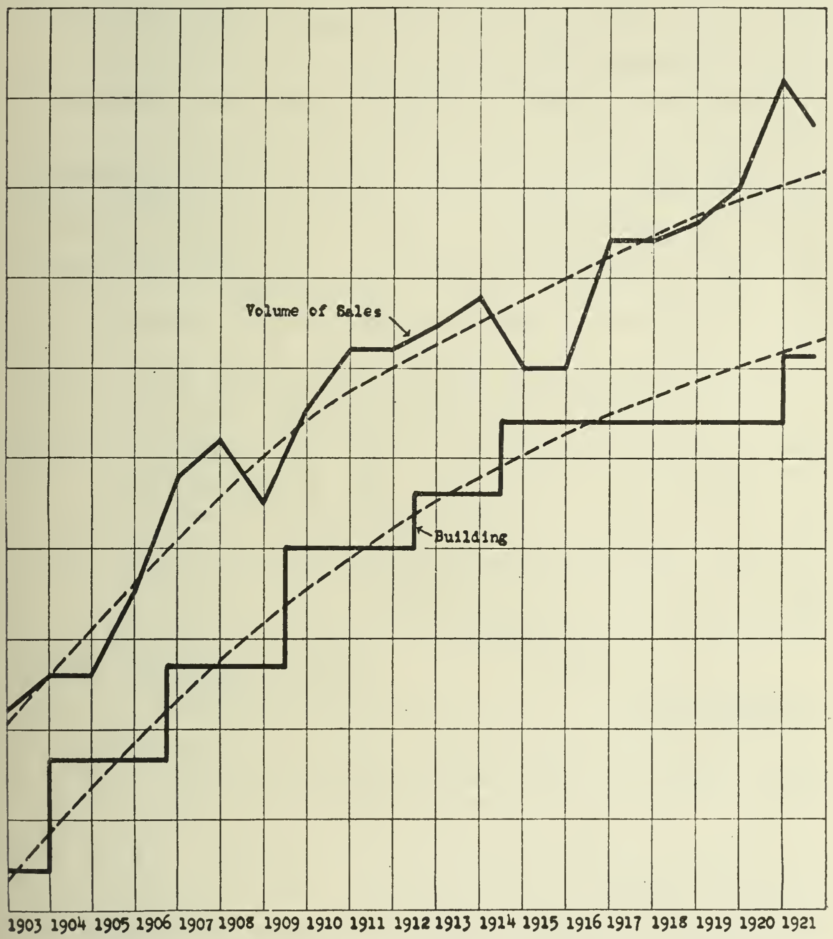

Chart 4. Building Program Related to Course of Sales

On the rise of the cycle cash requirements increase out of all customary proportions because of the lag between outgo and income—the outgo applying to a period further along the cycle than the income. During the full swing of the cycle the relation between quick assets and quick liabilities must vary tremendously. The two-to-one ratio which has largely been applied in banking may thus be advantageous through some sectors of the cycle and very dangerous through others.

The same considerations as to cash capital requirements that apply to an established business during the up-swing apply also to the young business during its period of rapid growth. Not a few of them have passed off the stage or out of the hands of their founders because their profits tempted them to put upon their cash strength too heavy a burden of this temporary sort.

A knowledge of the cyclical trend is very important in the determination of how much should be distributed in dividends and how much should be withheld as reserve or surplus. The only way to reach a proper solution is to make some estimate of what the cash requirements and the probable profits will be for the next few years, and to act within the safe limits of probability.

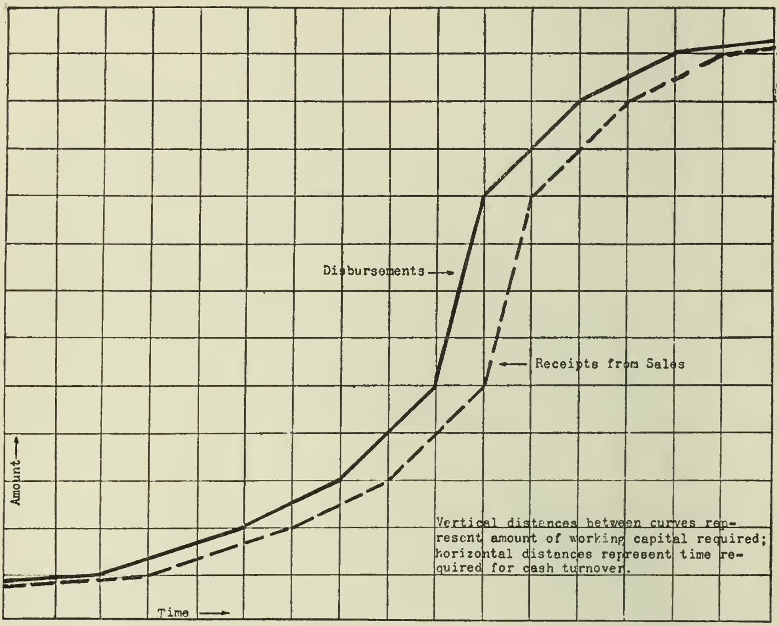

Chart 5. Relation of Disbursements to Receipts from Sales in the Upward Swing of the Business Cycle

THE CREDIT DEPARTMENT

During boom times orders are free and credits easy; nevertheless, it is then that the Credit Department can get busy and save a good bit of the losses during depressions. For when orders begin to crowd capacity, some must be lost on account of delivery time; the Credit Department should do its best to save the company from losing a prompt customer in order to serve an uncertain one. In our own case we use the oversold boom times to improve the average dependability of our accounts by stiffening our standards at the credit desk. New orders are then seldom accepted from customers of poor record.

Collections begin to fall off when a depression starts, and as soon as the first signs of the coming slump become evident we make arrangements to follow more closely all fair-sized accounts just as soon as possible after the date of maturity. Those of our customers who were still slow to pay offered the usual group of reasons—slowness in their own collecting, overstocking of shelves, lack of capital, inability to borrow from bankers, cancellation of orders, unemployment, lack of orders resulting from closing of mills, decrease in yield of crops, and war taxes. As a result of these excuses they asked for long extensions of time, payments on account, note settlements, or expressed the desire to return the goods.

Because of the difficulty of collecting during depression there is the temptation to restrict credit during such times. This, we believe, is a mistake if it results in the curtailment of sales when sales are needed most. One must scrutinize credit very carefully at such times, but it pays to take a much bigger chance when one needs the orders than when he does not. We expect, of course, a bigger ratio of loss in depressions, but as far as possible we want that loss to result from orders taken when they are needed, rather than from orders taken months before, manufactured on overtime pay and in conflict with orders for good-pay customers.

The results we can show from adopting a policy of rigid credits during times of expansion are interesting. Scientifically, of course, they cannot be called conclusive since they represent only one experiment, but they bear out very well the *a priori* suppositions. During the depression extending from September, 1914, to August, 1915, the ratio of our losses to sales was 0.0052. During the prosperous year of 1920 the ratio was 0.0005. During the 11 months of depression in 1921, following the careful preparation of the Credit Department, it was 0.0013. It would seem on the surface, therefore, that we had reduced our losses 75 per cent by this policy of preparedness.

### MERCHANDISING

The time to launch new merchandise lines is not during boom times when the factory has enough orders for lines already established to keep it busy, but during slack periods when it needs the work. But in order to have these new lines all ready we must study ways and means, and have plans and originals all drawn up before the depression arrives.

It is at such times, when the purchasing public is apathetic, that the wide-awake merchandising manager is on the constant lookout for new and interesting things to quicken the pulse of business. Things that buyers have never had before they will often buy, no matter how bad business is. We have found, for example, in the case of tags, that customers who would not buy ordinary tags were willing to buy when we made up some new attractive design which especially appealed to them. In the case of crepe paper, the inauguration of the paper hat novelty gave us larger sales of crepe paper this year than we have ever had before. We have had similar success with sealing wax novelties which have helped to boost the sales of sealing wax very considerably. The preparation for all these had been carried on in boom times.

Above all things we do not fire our salesmen during times of depression. The time to fire salesmen, if we are going to fire them at all, is during prosperity when we have more orders than we need. Depression is the time to take on more salesmen, if finances will in any way allow.

Like new lines, new advertising should also be prepared by manufacturers during prosperity so that it will be ready to launch when the critical moment arrives. As a matter of fact, however, most business concerns advertise more during prosperity than when business is poor. This fact is shown by its influence on the price of paper. What is the use of a manufacturer advertising when he already has all the orders he needs? He should save it up, keep planning, and launch the campaign when he needs the business.

## PERSONNEL MANAGEMENT

At no time does the advantage of a versatile labor force show up so strongly as during depression when it is necessary to carry absolutely no superfluous help and yet to have enough to insure prompt deliveries. Employees who can be shifted from one department to another without loss of efficiency are decidedly valuable. To train employees to do different classes of work and to keep careful records showing who they are, is therefore more than ever necessary when business is slack. If additions and improvements are made during periods of depression it is often desirable to transfer manufacturing people to construction work at this time. Rearrangements can be carried out during depression when work is slack. Stores can be put in order and other jobs of the kind can be done. Producing machinery should be repaired during business slackness when the machinery is idle, for during prosperity repairs often mean a loss of valuable time.

Throughout the whole wide range of business activities, management can thus make practical use of a study of cycles. The unimaginative manager will, of course, wait until we can predict for him exactly the day of the crash. Meanwhile some of his competitors will run a few circles around him by using as a guide to their judgments, in some such ways as I have here tried to describe, the partial information now available.

## DISCUSSION[1]

### By F. L. Lamson

Any paper on management and business by Mr. Dennison is sure to be of contributory value to managers in industry because Mr. Dennison possesses that rare qualification—a balance of vision and practical experience; and his paper this afternoon is an excellent example of this because in it he has pointed out an ideal method of approach to the vital problems of management, and has demonstrated how he has applied these ideals in his own business and proved their success. A study of this paper by managers and heads of departments in every industry, and the application of these methods will go a long way toward flattening the peaks and filling the valleys of the business curve, and making it what it should be—a cycle.

The first part of Mr. Dennison's paper is most ingenious. In it he proposes to statisticians and economists that they incorporate into their sciences graphical charts of thought, sentiment, opinion, and judgment. For what are needs or requirements, or what are financial resources, except judgment? And what is price expectation? Yet, as every one must feel from Mr. Dennison's presentation, there is unquestionably a fundamental law underlying all these forces of thought and judgment, and it is therefore highly imperative that students of the activities of the human mind discover what that fundamental law is, and show how it operates and how we can apply it in the management of our industries. A colossal problem it surely is; but yet if by practice, experiment, and continuous study such graphical pictures could be added to Management's Guide Book, it would most surely put more real science into the management of industry.

Mr. Dennison's methods and their application, as set forth in the following divisions of his paper—"Fixed Investments," "Distribution," "Merchandising," "Credit and Purchases,"—are beyond question based upon the soundest possible business principles, and they must be recognized as good financing and their story told in modern and approved accounting. The one point that Mr. Dennison did not cover in discussing these subjects was one which some of us have found a bit disturbing—the fact that in setting aside profits in times of prosperity to be used in times of depression, considerable correspondence has taken place between us and certain departments at Washington.

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[1] Also read at the Annual Meeting.

My criticism of Mr. Dennison's paper is that he should have given greater emphasis to what he merely refers to in a single sentence, namely, "The greatest need is for timely statistics, well presented and widely distributed." He says further: "Supply is regulated . . . by what the supplier thinks the demand will be," and also "If the supplier's prediction were always correct, there might be no such thing as our present business cycle." To be sure, Mr. Dennison tells how best to use what is available, but it is evident that if more and better and really timely statistics are made available, so much more will Mr. Dennison's plan contribute to better management.

It is my hope, therefore, that the associations here assembled will pledge their support to the United States Department of Commerce in its effort to supply reliable, comprehensive, and timely statistics, the present effort of the Department being manifested in its monthly publication entitled *Survey of Current Business Conditions.* This work of the Department of Commerce is one of the greatest contributions to management which has come to industry, and it is worthy of the constructive criticism and suggestions of economists, statisticians, and business men, and should have their unqualified support. Every possible assistance should be given the Department in its effort to present the data in the best form for all classes of industry and management; and in this connection, I venture to suggest that the sources now furnishing information undertake to furnish what the *Survey* does not now contain, namely, a normal for each industry as the basis of comparison, rather than the conditions of business in 1913. By that I mean that each manager of a plant knows what the normal production for his plant is and how, at any time, he is operating with reference to that normal, and if such a basis were taken all industrial activities could be shown monthly with reference to it as a standard, and it would furnish to managers and executives a most substantial basis for the application of Mr. Dennison's methods in management.

Persons desiring to know more in detail the full purport of the suggestion which I have made here may be interested in reading my article, "Production Statistics Vital to All Industry," published by the United States Chamber of Commerce.

# THE NATURE AND STATUS OF BUSINESS RESEARCH[1]

By Leonard P. Ayres, *The Cleveland Trust Company*

The job of the business statistician is to look into the future. He is employed to furnish those in positions of top control in his firm with a fact-basis for their thinking and acting. If he can do this successfully he becomes one of the most valuable men in the organization. His is a difficult and an exacting job, for it involves a most unusual combination of theoretical knowledge with the ability to transform his theory into recommendations for practical action.

The university economist and the governmental statistician are seldom called upon to submit their conclusions to the immediate and drastic test of application. The successful business man is usually innocent of any thorough understanding of the economic laws affecting his operations, or of the statistical technique by which the lessons of previous transactions may be interpreted. It is the business statistician who is called upon to bridge the gap between knowing and doing.

Because they fall short of measuring up to these high requirements, business statisticians have in general failed to take positions of large influence in commerce, industry, or finance. Most of the larger and many of the smaller industrial firms have statistical departments, but in only a few instances have the men in charge become influential factors in the business world. More serious still is the fact—which must become apparent to any one who has occasion to study the finances of business establishments in these troublous times—that in few cases has the work of the business statistician exercised any large influence within his own organization. It is worth while to seek the causes of these conditions.

## THREE DIVISIONS OF WORK

The work of the business statistician in the industrial establishment is closely related to the three great divisions of the firm's own activities. The first of these relates to the purchase of raw materials, the second to production, and the third to the sale of the output. In each case the task of business research is to study the figures of the past and the present, and from them to draw just inferences as to the probable future. The terms in which this work is done are those of time and money. The importance of business research depends on the degree to which it can increase money returns. The value of the business statistician is measured by his effectiveness in swelling the firm's income. The results of the work must lead to recommendations relating to profits.

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[1] Read at the Eighty-third Annual Meeting of the American Statistical Association at Pittsburgh, Pa., December, 1921.

When these conclusions and recommendations are formulated they are submitted to the immediate test of events, and if they are erroneous that fact becomes not only obvious but frequently expensive. There are few fields of endeavor in which the requirements are so severe, the controlling factors equally numerous and uncertain, and the validity of the work so promptly and definitely determined.

### THE GENERAL BUSINESS CYCLE

The most important single piece of business information at any given time is that which tells of the existing status and development of the general business cycle. This means that the business statistician must have a thorough acquaintance with the literature of this subject and a pretty incisive understanding of current developments as they become active factors in the cycle's development. This single requirement entails a good education, a fair grounding in economics, and a considerable command of statistical technique.

### THE BUSINESS CYCLE OF THE INDUSTRY

Supplementing this foundation of knowledge relating to the general business cycle, he must have an intimate and constantly growing knowledge of the business cycle of his own particular industry. He must realize such facts, for example, as that when prices are changing in response to general business movements, those of cotton goods fluctuate more widely than do those of woolen goods, and that both of these normally swing through a wider range than do the prices of leather goods. He must discover and develop for his own industry facts of this general sort, and he must by careful test and study find out which among them are trustworthy general laws, and which are merely contingent and incidental occurrences.

He must carry his studies further and bring to light for his own business those apparently contradictory counter currents that disturb the laws of business when the general tide is setting strongly in toward prosperity, or ebbing to depression. Such contradictions are found when incomes are reduced and people begin to use more cotton but less wool, or more flour but less meat, or when they stimulate the paint business because they have suddenly decided to make their old rolling stock or agricultural implements serve one more year. Again, in times like the present, the business of companies manufacturing multigraphs and similar machines is increased because firms feel the necessity for advertising but wish to do it in an inexpensive manner.

### THE MONEY MARKET

Still other fundamental conditions with which the business statistician must be familiar are those relating to the money market. He should know something of the seasonal fluctuations in the cost of short-time borrowings, and a good deal about the laws which govern the expense of capital issues through stocks and bonds in periods of falling prices, as contrasted with those of rising prices. This is a requirement of the first calibre, but knowledge of this field should be included in the equipment of the business statistician if he is to make his work a true profession and demand that it be accorded a first-class status.

### WAGES AND THE COST OF LIVING

In the parts of his work which more directly relate to the operations of the establishment the business statistician will find that he must keep conversant with the movements of the index numbers for wages, employment, and the cost of living. Every time a change in rates of pay is under discussion he will be called on for information, explanation, and forecasting in these fields, and he will find, if he has to deal with progressive labor organizations, that no superficial knowledge or hasty generalizations will meet the needs of the case.

### ESTIMATING FUTURE DEMANDS

In addition to all that has been outlined there remains one more kind of activity, involving more real research, calling for greater sagacity, and requiring a higher type of ability. This is the estimating of the probable future demand for the output of the establishment or industry. One main reason why we have business cycles is that business men are commonly unsuccessful in making these estimates.

This work necessitates in part an application of actuarial methods to the data of markets and distribution along lines that have as yet hardly been marked out. These methods are needed especially in connection with articles which are quickly developed and which meet so generally felt a need that large numbers of people desire to secure them promptly. Among such articles may be mentioned harvesting machines, typewriters, bicycles, phonographs, and automobiles.

In the cases of such articles there are two distinct phases in the development of markets. The first is that which the supply departments of the army termed during the war the "problem of initial equipment." It consists in furnishing large numbers of people with the new article quickly. The second phase is that of replacement, and consists in supplying old customers with new machines after their original purchases have been worn out or superseded.

The fact of outstanding importance about these two phases is that the productive capacity that is built up to meet the demands of initial equipment is nearly certain to be greatly in excess of that which can possibly be used when the market becomes one of replacements. The laws governing these industrial changes are largely susceptible of statistical formulation. The principal controlling factors are the number of users, the annual output of the industry, and the average life of the article. The possibilities of export trade, and the degree to which old models can be superseded by new and improved types, are additional factors.

The formulation of the laws that are involved for any particular industry or product calls for incisive and sequential thinking based on carefully collected and accurately recorded information. Such work well done will yield returns of the first importance.

### DETERMINATION OF TRENDS

The estimating of future demand is quite as essential in the cases of articles and commodities that do not have the characteristics of those just considered. Here again methods have been but imperfectly formulated, and the work that remains to be done will call for the best ability that statisticians can bring to bear. This work depends largely on the estimating of long-time or secular trends. It is essentially a matter of prophesy. To deal with it adequately the research statistician will require a good working knowledge of correlations. He will need this not so much because the correlations themselves will have to be computed, as because he will need to use the regressions which are involved in the correlations.

These regressions are measures of trends. In their very nature they are prophecies and, if judiciously used, they throw open to the field of business research a series of devices which have only recently become commonly available, and which have a most important practical value.

Moreover, there are some cases, and most important ones in the business field, where still more complicated techniques will justify themselves in the practical results they will bring to light. These are cases in which the result that is sought depends on the magnitudes of two or more controlling factors that may be measured in advance. For example, the probable volume of certain crops may be estimated in advance from the figures of temperature and rainfall recorded during the spring and early summer. The making of such estimates involves the use of regressions from multiple correlations. This methodology, which is still in the stage of development, will later on be used for estimating the probable future demand for commodities and manufactured articles.

### A NEW PROFESSION

The types of work that have been described as included among the activities of the business statistician call for thorough training, a wide range of knowledge, and a considerable amount of resourceful ingenuity, combined with an unfailing ability to turn out results of practical usefulness. They are not merely economics, although a good grasp of economics is involved. They are not entirely statistics, although they require a high grade of statistical ability. They are not exclusively research, although they include real research of an exceptionally applied sort.

More and more work of this sort is going to be done. The need for it is almost without limit. The materials and methods for carrying it forward are at hand in a profusion entirely beyond anything that existed or could be foreseen even five years ago. Persons with the requisite training and ability to carry it forward are beginning to appear. Probably it constitutes a new profession, included within statistics, but sufficiently specialized to demand individual recognition.

### BUSINESS STATISTICS TRADITIONALLY CLERICAL

It must be admitted that for the most part statistical work in business organizations is not now being carried forward on anything like the levels that have been suggested, nor are most of our business statisticians competent to do the kinds of work that have been described. It is probably true that most of the business statisticians in American industries have come up through the clerical or accounting forces and have been given the title of statistician because they proved a little more able than their fellow workers to compile rapidly the information demanded from time to time by the executive officers.

The status of the statistician in business depends on the capacity he may possess to free himself from the clerical traditions that surround his position. So long as it is his job to produce the figures that are called for as promptly as possible, and hand them over to his superior officers to interpret and apply, his office will remain one of relatively limited importance.

He will carry forward real research only as he finds or makes opportunities to do his work by scientific methods, and this involves in business, as elsewhere, the four processes of analytic scrutiny, exact measuring, careful recording, and judgment on the basis of observed fact.

### INTERPRETATION

Two conditions are necessary if the work of the business statistician is to be carried forward on productive scientific lines. The first is that his office shall be one of interpretation and presentation, rather than one charged with the duty of compiling primary records. His job is to sort out the essential facts from the great mass of merely incidental ones, and to interpret their significance. He must have time to study, combine, and compare his figures, and to point out their meaning. If he is mostly concerned in tabulating, or in supervising a force of clerks that are doing it, he will not have much time or opportunity for his real job.

### PRESENTATION

The second requisite condition is that he shall personally present his results to those who must base actions and policies upon them, and he must participate in the discussions concerning them. By no other method can the value of his work be fully utilized, and there is no other process that is equally effective in improving its quality.

### GRAPHIC METHODS

If the research statistician in business is to present and explain his results to officers' committees, executive committees, and boards of directors he will have to cultivate the ability to write simply, to speak with lucid brevity, and to use graphic methods skillfully. The last of these three requisites is by no means the least important. It may be laid down as almost a fundamental principle that the statistician who is to be successful in business must cultivate the graphic methods. He will shortly find that numerical relationships that are at all involved cannot be understood by many business men unless they can see them represented by lines and surfaces instead of by numbers. This requires the use of diagrams.

### REWARDS AND REQUIREMENTS

It may appear that unreasonable demands have been made in the foregoing pages on the research statistician in business. He must be a well-trained statistician, with a good knowledge of economics, and a working acquaintance with accounting. He must speak and write convincingly, and know how to use diagrams effectively. He must be well endowed with that type of sound judgment that will insure the practical utility of his findings and recommendations.

These demands are not unreasonable, for business needs men of these qualities in its statistical positions, and it is abundantly able to pay them well. There is hardly a large corporation in America that would not find it to its advantage to employ such a man, if it could find him, and to give him the status and pay of a vice-president or an executive officer. This opinion is reinforced by the mass of evidence now coming to light indicating that many scores of business concerns are now in financial difficulties as a result of their entire disregard during the past two years of rather elementary principles concerning such things as price movements, interest rates, and the sequence of events in previous business cycles.

It may fairly be asked of the statistician that if he aspires to such a position in business as the truly competent man should be able to secure, he give evidence of his capacity through technical preparation, and by contributing to the published literature of his profession articles on statistics and business research that can successfully bear the critical scrutiny of his professional co-workers. In proportion as business firms demand such standards and reward them, and statisticians equip themselves to meet them, business research will move forward to its rightful place among the professions. That place will be a high one.

## DISCUSSION[1]

### By C. S. Duncan

With the paper of Mr. Ayres', both as to its letter and its spirit, I am in hearty accord. It is, however, a high standard that he sets, which probably must remain for some time an ideal or a goal rather than a realization. I do not like the term "business statistician" as applied to the work of business research. The generally accepted meaning of statistician is, in my opinion, entirely too narrow for the one engaged in economic research. There are many occasions when statistical material and statistical methods would be of subordinate consideration.

The man engaged in business research may become the guide, philosopher, and friend of the management, or he may remain in a much lower, clerical position. In my judgment, persons who come into this field of endeavor will rather generally find their own level. If they are clerical minded, they will probably remain clerks. If they have executive or directive ability, they will doubtless reach positions of authority. In general, the research worker in business, like every one else, will achieve the success that his ability can win for him.

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[1] Also read at the Annual Meeting.

While not criticising the paper specifically, I would like to call attention to the fact that there are problems in the field of business research that are especially adapted to different kinds of organizations. There is work that a governmental agency can best perform; and, personally, I am pleased to see that the Department of Commerce is extending its interest and is seeking coöperation with business men in an economic and statistical study of business problems. Research work is an expensive proposition. A governmental agency can secure the funds for collecting data which would not be within the scope of the individual concern. There are, also, problems connected with an entire industry or trade whose solution could probably best be sought through the medium of manufacturers' associations or trade associations. There is a work in which the banks are especially interested, and there is the work with individual concerns of both manufacturers and merchants. In all of these cases the problems are somewhat unique, and it is likely that one who is fitted for work in certain fields may not be fitted for work in others. Nevertheless, it will undoubtedly prove true that all the skill and training acquired by the individual will at some time prove of service to him. There is, for instance, one further qualification for a research worker not mentioned in Mr. Ayres' paper that I consider of much importance. This is a knowledge of at least the elementary principles of accounting. There are many business problems demanding the use of such knowledge.

There is something like an appeal which I desire to make for those who have at least temporarily left the universities for practical business research work. There should not be the impression which is felt in certain quarters that every man lowers or loses his standards of workmanship when he makes this change. Until it is proved otherwise, he should continue to be considered a man of integrity and principle with a desire to seek the truth. More specifically, university men should realize that those who are engaged in business research have an equal desire to secure comprehensive data and to make their investigations thorough and complete. Failure to achieve desired results lies not in the lack of desire, but rather in an inability to secure the facts.

It has been said by Mr. Ayres that business research is becoming a profession. I do not question the tendency in that direction, but I do think that today it is not a profession. There is no definite field. There is no definite body of facts. There is no set of principles distinguishing business research from other activities. Bluntly stated, he is the successful research man who makes good at his job. It is not possible for him to anticipate what that job will be, but of one thing he may be sure, namely, that over and beyond statistical training and all purely technical qualifications there is a primary need of good sound judgment. Frequently today this is the quality more to be desired than statistical skill or economic learning. Judgments or decisions must be made when the occasions for them arise. They often will not wait for the statistical process to reach completion. Policies must often be determined by the facts in hand, however incomplete these facts may be. As matters stand today these decisions must be made, and the value of the trained worker in business research under these circumstances is probably to show that more data must be had before another such occasion develops. At the same time he must make the best possible use of everything that is available.

It is clear, then, that Mr. Ayres and I do not really disagree. I have wanted to put a little more realism into the picture than he has given in his paper. That we should all work for more scientific method in research is no doubt a position to be endorsed by every one. The first task, however, is to find an opportunity to work, and then to present the conclusions in such manner that the business executives will and must consider them. Business research is today seeking to establish itself along this line.

# CYCLES OF EMPLOYMENT AND UNEMPLOYMENT IN THE UNITED STATES, 1914–1921

By W. A. Berridge, *Harvard University*

The relation between unemployment and the business cycle may be regarded in either of its two aspects. Students of unemployment are chiefly interested in the role of the business cycle in unemployment, that is, the part played by depressions in causing unemployment and distress. Students of the business cycle are, or should be, interested in the opposite aspect, the role of unemployment in the business cycle. Yet the literature on the business cycle indicates a remarkable neglect of unemployment, except for a secondary interest on the part of some writers in cyclical unemployment as a social problem. Writers on both subjects have been inclined to assume, explicitly or tacitly, that the American data on unemployment were not worthy of intensive analysis either as a measure of the social problem or as an index of business conditions. Moreover, this subject seems to be neglected increasingly by the authorities on the business cycle. Some of the earlier writers, such as Burton,[1] Tougan-Baranowsky,[2] Laurent and Georges Cahen,[3] showed more than ordinary interest in unemployment; but when we come to Mitchell and Persons,[4] whose great works are today among the most authoritative on the business cycle, we find unemployment practically ignored. Those who have been willing to concede any place to unemployment as a register of the business cycle have generally based their views either on deductive reasoning or on an examintion of the unemployment percentages for Great Britain. No writer on unemployment or on the business cycle has ever undertaken a rigorous quantitative analysis of the American data on employment and unemployment.[5]

[1] Theodore E. Burton, *Financial Crises and Periods of Industrial and Commercial Depression.* New York: D. Appleton & Co. 1902.

[2] Michel Tougan-Baranowsky, *Les Crises Industrielles en Angleterre.* Paris: Giard et Brière. 1913.

[3] Georges Cahen and Edmond Laurent, *Rapports Présentés au nom de la Commission sur les Indices des Crises Economiques*, etc. Paris: French Labor Office. 1911.

[4] Professor Mitchell mentions the unemployment *problem* on several occasions, but gives little attention to any *data* except the British. (Wesley C. Mitchell, *Business Cycles.* Berkeley, California: University of California Press. 1913.)

Professor Persons refers to unemployment in only one connection. He gives as one reason for an index of business conditions its possible usefulness to "government officials when handling the problem of unemployment." (Warren M. Persons, "Construction of a Business Barometer Based upon Annual Data," *Amer. Economic Rev.*, vol. 6, p. 739, Dec., 1916.) In his much greater work on monthly indexes, Professor Persons does not even mention unemployment. (*Indices of Business Conditions.* Cambridge, Massachusetts: Harvard University Press. 1919.)

[5] See Hornell Hart, *Employment Fluctuations in the United States, 1902–1917*, Cincinnati, Helen S.

The purpose of this and the succeeding articles is therefore to show wherein these American data are useful in the study of unemployment and in the study of the business cycle. In the present article, which is devoted to the war and post-war periods, the first task is to survey the field of current data on the subject, and from the data to construct if possible a continuous *index* of general industrial employment from the outbreak of the war to date.[1]

During the period under review, several state and national bureaus have collected quantitative information as to employment conditions. The leading state organizations which have attempted to do this are located in New York state, Massachusetts, Wisconsin, and New Jersey.[2] *A priori* there are certain considerations which show the relative merits of these states as representative samples of the industrial situation. Table I shows the relative importance of the four states in the total number of industrial wage-earners, according to the Censuses of Manufactures. New York ranks far above the other three, and indeed ranks above all the other states in the Union, having almost one sixth of the country's manufacturing industry, or about twice the quota of Massachusetts, three times that of New Jersey, and five times that of Wisconsin.

TABLE I

GEOGRAPHICAL DISTRIBUTION OF WAGE-EARNERS EMPLOYED IN MANUFACTURING INDUSTRIES[a] IN SELECTED STATES

(Unit: one per cent)

| | 1914 | 1909 | 1904 |
|---|---|---|---|
| United States | 100.0 | 100.0 | 100.0 |
| New York | 15.0 | 15.2 | 15.7 |
| Massachusetts | 8.6 | 8.8 | 8.9 |
| New Jersey | 5.3 | 4.9 | 4.9 |
| Wisconsin | 2.8 | 2.8 | 2.8 |

[a] Source: *Abstract of Census of Manufactures*, 1914, p. 272. The decennial Censuses of Occupations disclose a similar relationship.

Further economic considerations also suggest the key position of

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Trounstine Foundation, 1918, and William M. Leiserson, *Unemployment in the State of New York*. New York. 1911. Mr. Leiserson of course confines himself to New York data; and his statistical analysis of even these is not rigorous. Mr. Hart's study is comprehensive and highly laborious, but is unfortunately foredoomed to failure by the nature of the method employed. He seeks to measure the total volume of unemployment by subtracting the total "volume of employment" from the total "normal labor supply" in the United States. In both of these large quantities there are considerable errors of estimation, which of course assume a much greater relative magnitude when applied to the difference between the two quantities.

[1] Presenting in expanded form one section of an article in the *Rev. of Economic Stat.*, prel. vol. 4, pp. 17–56, Jan., 1922.

[2] Two states are purposely omitted: Illinois, owing to the very recent inauguration of the series (May, 1921); and Pennsylvania, because data were reported only for a short time early in the war.

New York state compared with New Jersey and Massachusetts—its greater industrial diversification[1]; its peculiarly favorable location in relation to coal, iron, and other raw materials, and, normally, to the supply of immigration; its access to the import and export trade by way of the Port, and to interior markets by the canals and the Great Lakes, as well as by rail; finally, the central geographical position of New York with reference to the other great industrial states.

Remembering these differences in the industrial importance of the several states, we may review briefly the leading employment data available. In Chart 1 are shown three semi-adjusted indexes, those of the United States Bureau of Labor Statistics and the Industrial Commissions of New York and Wisconsin; also two wholly unadjusted series, one representing the original items reported until December, 1918, to the New Jersey Bureau of Labor Statistics, the other representing the items reported to the United States Employment Service since January, 1921.

The first curve in Chart 1 represents the semi-adjusted indexes based upon the month-to-month link relatives reported by the United States Bureau of Labor Statistics. These have been compounded into chain relatives, which in turn have been combined for the several industries, using weights proportional to the importance of the industries according to the 1914 Census of Manufactures.[2] These weighted chain relatives have then been reduced to the average for the census year 1919 as a base, yielding a series with several points of merit. The geographical distribution of the data is fairly broad, covering the largest manufacturing states, of which the fifteen in Table II are the most important. They are arranged according to the number of wage-earners employed in the boom of 1920 and the depression of 1921.

In industrial make-up the series is somewhat peculiar. In the distribution of the 600,000 to 800,000 wage-earners actually embodied in the returns, the automobile, iron, and steel industries are represented strongly, textiles and others lightly; but the process of weighting by the Census of Manufactures turns the tables, greatly reducing the emphasis on metal industries and stressing the textiles instead. A glance at Table III (a) will show that the groups have been so selected that those falling under "textiles" have a weight of about 45 per cent, and those falling under metals, about 35 per cent. This gives a much

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[1] Pennsylvania is the only state which excels New York in the scope and diversity of manufacturing industries. See XIII Census, *Supplement for New York*, 1909, p. 689. In Massachusetts, on the other hand, two or three industries are dominant—cotton especially.

[2] These unpublished figures have been kindly supplied by Mr. Ethelbert Stewart, U. S. Commissioner of Labor Statistics. It is the intention of the writer to change the weighting to conform to the 1919 Census returns, upon their appearance.

CHART I-RECENT DATA ON EMPLOYMENT IN THE UNITED STATES

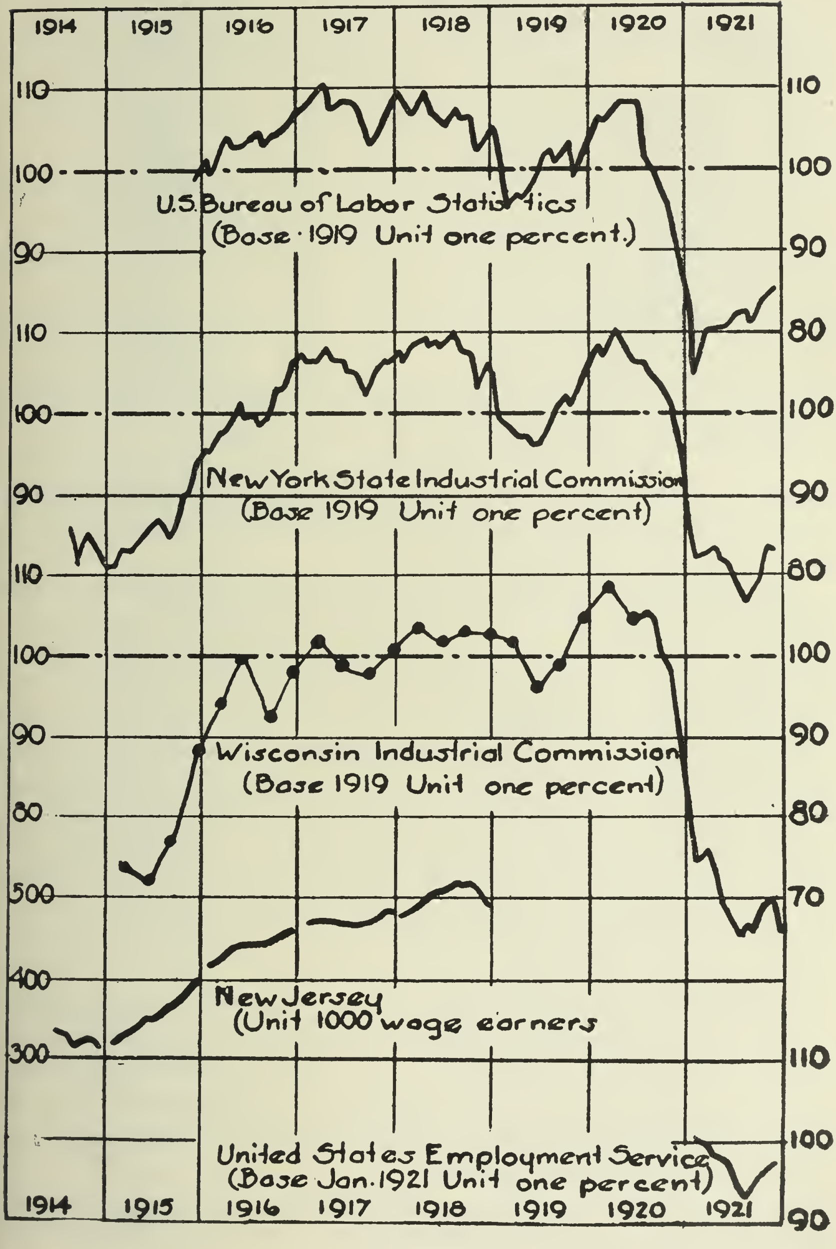

TABLE II

GEOGRAPHICAL DISTRIBUTION OF UNITED STATES BUREAU OF LABOR STATISTICS DATA ON EMPLOYMENT[a]

(Unit: one per cent)

| | March 1920 | July 1921 |
|---|---|---|
| 1. Pennsylvania | 19.7 | 16.4 |
| 2. Massachusetts | 12.8 | 14.9 |
| 3. Michigan | 13.0 | 13.3 |
| 4. New York | 12.6 | 12.2 |
| 5. Ohio | 9.0 | 7.1 |
| 6. Illinois | 6.8 | 6.9 |
| 7. New Hampshire | 2.5 | 3.8 |
| 8. New Jersey | 2.7 | 3.1 |
| 9. Missouri | 2.2 | 2.7 |
| 10. Indiana | 2.8 | 2.4 |
| 11. Maine | 1.7 | 2.1 |
| 12. Rhode Island | 1.5 | 1.8 |
| 13. Alabama | 1.7 | 1.8 |
| 14. Connecticut | 1.4 | 1.5 |
| 15. Colorado | 1.3 | 1.1 |
| Other states | 8.3 | 8.9 |
| Grand total | 100.0 | 100.0 |

[a] Data supplied by Mr. Ethelbert Stewart, Commissioner of Labor Statistics.

stronger representation to the textile industry than is justified by the Census of Manufactures, in which the textile industry amounts only to 21 per cent of all manufacturing.

The second curve in Chart 1 represents, in semi-adjusted form, the employment index of the New York State Industrial Commission. This index includes on the average about a half-million wage-earners. Although restricted geographically, it is superior in industrial composition to the index just described. It is especially significant that machinery, iron, and steel form an influential component of this index, since it has been shown that employment fluctuations in the metals and machinery industries in New York state register very accurately fluctuations in other lines of industrial activity.[1] Overweighting the metal group, therefore, is more advantageous than otherwise; whereas the overweighting of textiles, especially cotton, introduces in pronounced form the effect of crop cycles which in a considerable measure are independent of business cycles.

The first two curves in Chart 1 show a remarkably close agreement in both timing and amplitude. Each of the slight discrepancies noted is wholly attributable to differences in the industrial distribution: textiles are represented strongly in the Bureau of Labor index, but only weakly in the New York index, in which metals, machinery, etc., outweigh textiles and their products.

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[1] The relationship is even more conclusively demonstrated by the employment data than by the production data analyzed by Professor E. E. Day. *Rev. of Economic Stat.*, compare preliminary vol. 3, pp. 366–7, Dec., 1920, and vol. 4, pp. 29, 30, 37, Jan., 1922.

### TABLE III

### LEADING POST-WAR EMPLOYMENT DATA: INDUSTRIAL COMPOSITION

(Unit: one per cent)

(a) United States Bureau of Labor Statistics[1]

(*Standard weights based on United States Census of Manufactures, 1914*)

| Industry | |
|---|---|
| 1. Iron and steel (blast furnaces, steel works and rolling mills) | 12.0 |
| 2. Car building and repairing (steam cars, by railroads and other companies) | 17.0 |
| 3. Automobiles (including bodies and parts) | 5.5 |
| 4. Cotton goods | 16.4 |
| 5. Dyeing and finishing textiles (exclusive of that done in textile mills) | 2.1 |
| 6. Hosiery and knit goods | 6.5 |
| 7. Woolen and worsted goods | 6.9 |
| 8. Men's clothing | 7.5 |
| 9. Silk goods (including throwsters) | 4.7 |
| 10. Leather (tanned, curried and finished) | 2.4 |
| 11. Boots and shoes (including cut stock | 8.6 |
| 12. Paper (including wood pulp) | 3.8 |
| 13. Tobacco (including cigars and cigarettes) | 6.6 |
| Total | 100.0 |

(b) New York State Industrial Commission[2]

| Industry | March 1920 | June 1921 |
|---|---|---|
| 1. Metals, machinery and conveyances | 38.4 | 30.1 |
| 2. Textiles | 10.8 | 12.4 |
| 3. Clothing, millinery, laundering, etc. | 13.2 | 14.6 |
| 4. Furs, leather, and rubber goods | 7.7 | 8.3 |
| 5. Food, beverages and tobacco | 8.0 | 10.6 |
| 6. Printing and paper goods | 7.3 | 8.4 |
| 7. Paper | 1.6 | 1.2 |
| 8. Chemicals, oils, paints, etc. | 5.3 | 6.0 |
| 9. Wood manufactures | 4.6 | 4.8 |
| 10. Stone, clay and glass products | 2.3 | 2.6 |
| 11. Water, light and power | 0.8 | 1.0 |
| Total | 100.0 | 100.0 |

(c) Massachusetts Bureau of Statistics[3]

| Industry | Aver. 1914 | Aver. 1918 |
|---|---|---|
| 1. Cotton and small wares | 21.5 | 16.1 |
| 2. Boots and shoes | 12.7 | 10.8 |
| 3. Woolens and worsteds | 9.0 | 8.5 |
| 4. Foundry and machine-shop products | 6.8 | 12.3 |
| 5. Electrical machinery | 2.8 | 3.0 |
| 6. Paper and wood pulp | 2.2 | 2.1 |
| 7. Leather | 1.7 | 1.5 |
| Total | 56.7 | 54.3 |
| Grand total | 100.0 | 100.0 |

(d) United States Employment Service (June, 1921)[4]

| Industry | |
|---|---|
| 1. Iron and steel and their products | 21.3 |
| 2. Textiles and their products | 16.7 |
| 3. Vehicles for land transportation | 11.3 |
| 4. Food and kindred products | 8.0 |
| 5. Metal and metal products other than steel | 4.7 |
| 6. Chemicals and allied products | 4.6 |
| 7. Railroad repair shops | 3.5 |
| 8. Paper and printing | 3.3 |
| 9. Leather and finished products | 3.2 |
| 10. Tobacco and its manufacture | 1.9 |
| 11. Lumber and its manufacture | 1.4 |
| 12. Stone, clay and glass products | .9 |
| 13. Liquors and beverages | .1 |
| 14. Miscellaneous industries | 18.1 |
| Total | 100.0 |

The employment curve for Wisconsin fluctuated in nearly the same manner as the others shown in Chart 1, except that the amplitude of its movement in the recent depression is somewhat greater. In form, the Wisconsin index more closely resembles the index for New York than that for the United States, because in Wisconsin as in New York the metal industries are very heavily represented. The Wisconsin curve in Chart 1 really represents not one series but two,[1] which though not wholly alike in nature have been grafted together by the Industrial Commission of Wisconsin. The figures reported monthly since July, 1920, are based on establishments representing one fourth to one third of the wage-earners engaged in manufacturing industries in Wisconsin.[2] The quarterly figures extending from the first quarter of 1915 to the second quarter of 1920 covered a much smaller proportion, probably 15 to 20 per cent. Differences in the inclusiveness, the industrial composition, and the purpose[3] of the two series of reports may account for the peculiarity in the form of the curve. It is especially probable that a standardization of the industrial weights in the two periods will make the composite series more trustworthy as a continuous record for the years since 1915.[4]

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[1] Source: Unpublished information furnished by Mr. Ethelbert Stewart, U. S. Commissioner of Labor Statistics.

[2] Source: *Labor Market Bulletin*, March, 1920, p. 4, and June, 1921, p. 4.

[3] Source: *Annual Report on Statistics of Manufactures*, 1914, pp. vii, xii–xv.

[4] Source: *Industrial Employment Survey Bulletin*, August, 1921, pp. 2, 3.

The two curves of original items at the foot of Chart 1 merit only passing attention. Employment in New Jersey increased during the war in much the same manner as in other states, so far as may be judged by the chart. The New Jersey data were not continuous between calendar years, and, furthermore, they were discontinued altogether in 1918,[5] so that the available fragments are not useful in setting up a current index of employment.

The index established in January, 1921, by the United States Employment Service has not yet covered a period long enough to prove or disprove its merit empirically. In general it has followed a course not unlike the New York and Wisconsin indexes during 1921, even though no recovery occurred in February, 1921, in the Employment Service index, as appeared in the other indexes. Theoretically, at least, the series seems promising. It covers about one and a half million wage-earners, a larger number than any other index now being reported currently. Its industrial composition, though imperfect, is on the whole well planned, being fairly representative of manufacturing in the United

[1] As to the industrial distribution of the earlier series of reports no published information is available. The following are the chief groups represented in the newer and more comprehensive series: machinery (19.3), automobiles (7.8), pulp and paper (7.2), railroad repair shops (5.3). The metal-working industries, including automobiles, railroad repair shops, and machinery, have amounted to 45 per cent of the total. Source: Industrial Commission of Wisconsin, *Bulletin 3*, pp. 3–4, Nov., 1920.

[2] For further facts on the nature of this series see Industrial Commission of Wisconsin, *Biennial Report*, 1918–20, esp. p. 81; also the Commission's monthly *Bulletins*.

[3] The purpose of the earlier reports was simply to obtain data on the incidence of industrial accidents, in order to check up the rates provisionally assumed in the workmen's compensation act. Until July, 1920, reports were made to the Commission only by self-insured employers, but after July, 1921, many employers insuring with the compensation companies began to report.

[4] The writer's surmise on this point is confirmed by the independent study of the problem by Mr. A. J. Altmeyer, Statistician to the Commission, whose intention is now to standardize the weights.

[5] According to a recent communication from Mr. J. A. T. Gribbin, who also kindly placed at the writer's disposal the unpublished data for 1917 and 1918.

States.[1] This series also has the advantage that current data are published earlier than those for other series, being telegraphically reported by the district directors of the Service and announced shortly afterward by the central office at Washington. It must, however, be admitted that corresponding to this advantage is the correlative disadvantage that some of the basic reports seem to be gathered by the directors from the employers by such methods and in such haste as to cast doubt on some of the results.

In Chart 2 are shown some fully corrected indexes of employment and unemployment available during and since the war. The second curve represents the employment cycles in Massachusetts, fully adjusted by a special method to form a continuous series.[2] The third curve represents the employment cycles obtained by analysis and inversion of the quarterly *unemployment* data for Massachusetts. The first curve represents the index that is probably the most reliable current measure of the general employment cycle in the United States. It is the average of the employment indexes of the United States Bureau of Labor Statistics and the New York Industrial Commission, corrected for seasonal variation, etc., like the other curves on Chart 2.

Why should the proposed current index be made up of these two components and no others? The choice hinges on the purpose in view. The purpose of the writer has been to construct an index with the following properties: (a) its components must have been reported in a comparable form for a sufficiently long period to establish a basis for empirical test, comparison, and appraisal; (b) it must be reasonably representative, industrially and geographically; and (c) its components must be reported currently, in monthly form, with reasonable promptness, and with accuracy. Among all these series only the above-mentioned combination meets the three tests. The Massachusetts employment series lacks the third property, since the monthly figures

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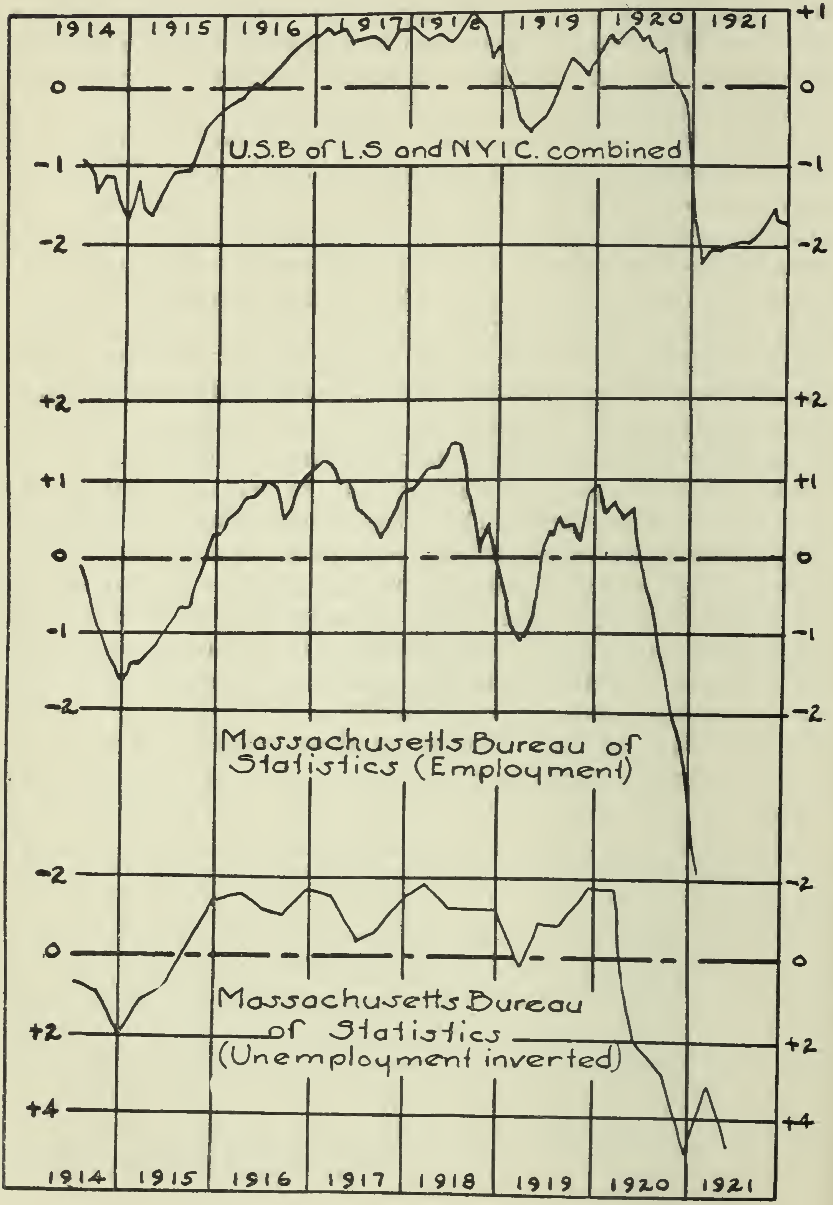
[1] The chief objections to its industrial composition are that (1) the iron and steel group is somewhat overweighted (21.3 v. 15.8 per cent of the aggregate); (2) textiles are underweighted (16.7 v. 21.3 per cent); vehicles are greatly overweighted (11.3 v. 3.7 per cent) and lumber greatly underweighted (1.4 v. 11.9 per cent).

[2] There are two reasons for applying a special method here: (1) The Massachusetts data are not continuous between successive calendar years, and for intercensal years are several degrees less complete than those collected in Massachusetts during the census years by the United States Census Bureau, and therefore were "stepped up" by 3 per cent to form, in conjunction with the census data, a homogeneous series; (2) the cotton industry is relatively much less important (approximately 6 per cent) in the country's manufacturing than in the manufacturing of Massachusetts (16 to 20 per cent). In view of the resulting exaggeration of the special crop cycles to which the cotton industry is subject, in addition to the ordinary business cycles, the cotton industry was analyzed separately from the others and combined with them on the basis of its importance in the entire country.

Throughout the present investigation the methods employed for elimination of seasonal variation, secular trend, etc., are substantially those devised by Professor Warren M. Persons (*Rev. of Economic Stat.*, prel. vol. 1, pp. 3–205, Jan. and Apr. 1919). Variations were introduced only where necessitated by the peculiar nature of some of the employment data.

CHART 2- CORRECTED INDICES OF EMPLOYMENT
(Unit one standard deviation)



for each year are not known until long after the end of the year.[1] The unemployment data for Massachusetts are quarterly, not monthly. The New Jersey series is defunct. The Employment Service data are so new that they fail to meet test (a). Indeed, both the index of the New York Industrial Commission and that of the United States Bureau of Labor Statistics fail when taken singly to meet the first half of test (b), since the former index has been shown to over-stress metals, and the latter, textiles. The latter meets admirably the second half of test (b) concerning geographical representation, and according to the industrial position of New York and to findings concerning employment in the pre-war period, to be discussed in a later article, the New York index should also be highly representative of the industrial states. Each of these two indexes meets test (a) better than do any others now being reported. The failure of the two single indexes to fulfil condition (b) as to industrial character is largely remedied by the mere process of combination: the textile and the iron industries are thereby restored more nearly to their true relationship. Admittedly, the groups including iron and steel and their products enjoy a weight somewhat (though only moderately) in excess of their true importance. This fact, in so far as it is true, constitutes a real advantage, because, as stated elsewhere, employment in the metal industries has for a long time fluctuated in striking harmony with employment in other industries combined.[2] In the light of all these facts, there is a very strong probability that the average of these two series shows the consensus of monthly employment fluctuations in the United States in recent years better than any other series or combination of series.

According to the corrected index based on these two series, employment has passed through some interesting phases during the past eight years. These fluctuations may be attributed in part to the business cycle and in part to other factors, notably the shutting off of immigration and the military demand for men. The depression of 1914–15, the war boom of 1916–18, the relapse during the half year after the armistice, the boom of 1919–20, the acute depression of 1920–21, and the incipient recovery in recent months are in a measure reflections of the change in the demand for production, and therefore in one sense simply a passive factor in the business cycle. But during the war employment became a potent limiting factor.

In April, 1917, our entry into the war introduced a tremendous new factor into the labor market. The military call for man power affected employment enormously for a period of twenty months. During that time the labor supply became one of the factors most drastically limiting economic activity. Enlistments, which increased immediately after our entry into the war, were supplemented by the first increment of the draft in the late summer of 1917, and in 1918 by several additional increments amounting to about two and a half million more men. The rapidly increasing drain of man power from civil life is shown by Chart 3, representing the total army personnel by months.[1] The number increased from 200,000 to more than 1,000,000 before the end of 1917, and to 3,600,000 at the time of the armistice, finally attaining a rate of increase of 400,000 men a month. These figures of course fail to tell the absolute magnitude of the loss of industrial wage-earners from civil life, because many other economic classes were likewise being drawn. They do, however, show fairly well the increasingly rapid rate of change in the supply of available man power, and consequently account for some of the dents in the employment curve. Undoubtedly, these dents would have been much deeper but for the heavy influx of women, youths, and young girls from home and school into industry, as well as that of adult male labor transferred from normal occupations in office or farm work to certain lines of manufacturing, under the double attraction of high wages and a deferred classification in the draft.

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[1] The only figures collected *currently* by the Massachusetts Bureau are those supplied to the United States Employment Service. These relate only to a very limited number of establishments, and are not strictly comparable with the earlier data.

[2] *Rev. of Economic Stat.*, prel. vol. 4, pp. 29, 30, 37, Jan., 1922.

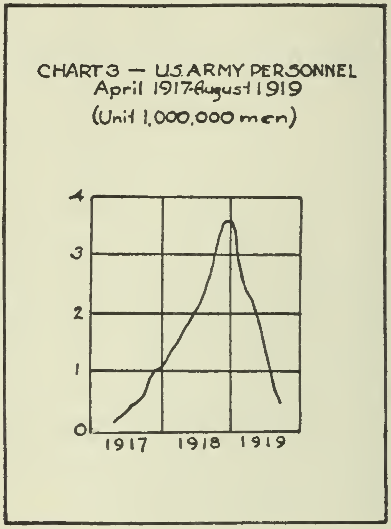

CHART 3 — U.S. ARMY PERSONNEL
April 1917-August 1919
(Unit 1,000,000 men)

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[1] Source: Colonel Leonard P. Ayres, Chief of Statistical Branch, General Staff, *The War with Germany, a Statistical Summary*, p. 15.

Demobilization shows an illuminating but quite different relation to the employment index. During the first six months after the armistice, discharges took place at twice the average monthly rate of mobilization, reducing the strength of the army from 3,600,000 to 2,000,000 by April, and to 1,000,000 before July, 1919. The discharge of enlisted men alone averaged 400,000 a month during the first half of 1919.[1] It is evident from a comparison of Charts 2 and 3 that most of this huge labor supply was being dumped on a falling market. At the time when employers were rapidly dismissing their employees in the post-armistice slump, soldiers were being discharged from the army. At the bottom of the slump in midsummer of 1919,[2] 2,000,000 soldiers had been discharged, several hundred thousand of whom must have remained unemployed for months before being reabsorbed in industry.[3] If the relapse of 1919 had not been fairly brief, there would have arisen still more urgently the question as to whether the demobilization policy adopted did not allow a rate of discharge so high that it hampered proper industrial reabsorption, and precipitated a needless unemployment crisis.[4] In either event, the labor supply previously withdrawn from the market by military demands was restored so soon after the war that when the recovery came in 1919–20 industry could proceed unchecked by such potent limitations as had prevailed in the two preceding years, and without need of resorting so widely to inexpert labor from other fields.

The monthly employment index affords a remarkably accurate picture of the production cycle. No comprehensive monthly data on production were available until recent years, especially post-war years. For the years 1919–21 Chart 4 shows the adjusted employment index, compared with a semi-adjusted index of the volume of manufacture. The latter is based upon Professor Day's "unadjusted index of the volume of manufacture," but since Professor Day has not yet eliminated seasonal variation from his unadjusted index, the writer has first eliminated that component of seasonal variation chargeable to the varying length of calendar months, dividing each monthly item of the unadjusted index by the number of days in that month, and multiplying by 30.4, the average number of days in a month; the next step was to divide the items resulting from the preceding step by their own standard deviation. The correspondence between the adjusted employment index and the semi-adjusted production index is astonishingly close, the correlation coefficient being 96.9 per cent. The writer has shown elsewhere that the *uncorrected* percentage deviations of employment and production from their respective trends fail to agree in amplitude. Production appears to respond with more elasticity; *i. e.*, it has a greater amplitude than employment, both above and below the normal trend.[1] But when these inequalities of amplitude are eliminated, as in Chart 4, the resulting cycles nearly coincide.[2] In view of the close relation between the two indexes since the war, it is probable that the corrected employment index itself affords a reliable picture of production cycles in earlier years, when comprehensive production data were not available.

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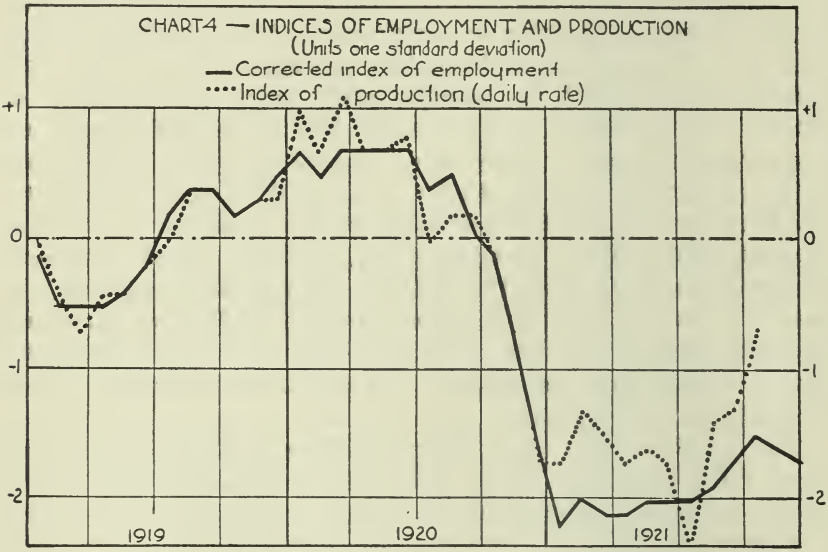
[1] Secretary of War, *Annual Report*, 1919, p. 17.

[2] This statement refers, of course, to the general index of employment. Employment had begun to improve earlier in the summer in some industries, notably textiles. See *Rev. of Economic Stat.*, prel. vol. 4, p. 25, chart 3, Jan., 1922.

[3] The situation disclosed by the two curves probably accounts in part for the prevalent impression that the soldiers returning in 1919 "did not want to work." Apparently lack of the opportunity to work was also a potent factor.

[4] It may be observed that approximately the last million men were returned to civil life in more moderate instalments, much better timed with reference to the business cycle.



It now seems abundantly clear that the interrelations of the employment data collected from independent sources during and since the war are of such a high order as to establish a fairly strong presumption in favor of their validity. The several indexes show such a clear agreement among themselves that the construction of a compound index has seemed justifiable. A convincing testimonial to the efficacy of the monthly employment index is found in its relationship to production throughout 1919–21, the only period for which a comprehensive monthly index of production can yet be constructed. Further supporting evidence of several kinds, which will be presented later, will demonstrate the validity of the employment data even more conclusively.

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[1] *Rev. of Economic Stat.*, prel. vol. 4, p. 18, Jan., 1922. For the reasons cited, see *ibid.*, pp. 18, 19.

[2] The parallelism is maintained in December and January. The drop in production during July of all years is due to hot weather, stock-taking, vacations, and a holiday.

In interpreting these results one should constantly bear in mind that the object of the present study has been merely to construct a continuous *index,* and not to estimate the actual *volume,* of unemployment—unemployment prevailing either at a given time or on the average over an extended period. As Bowley[1] well says of the British unemployment percentages, all these figures "can only be used to *measure* unemployment after a troublesome and hazardous estimate; their use is rather to form an *index* of unemployment which shall reach its maxima and minima at the worst and best times respectively, and fluctuate much or little as the state of the labor market is unstable or steady."

The index method for attacking the unemployment problem is not the one commonly used by writers on the subject, but to the present writer it seems to be the only one likely to yield results of high reliability. It is unquestionably the best for tracing the relation of unemployment to the business cycle, and it is not improbable that it offers the best possibilities also for the ultimate estimation of the *volume* of unemployment, though this latter point will require demonstration. In either event, it seems impossible to make even a reasonably accurate estimate of the volume of unemployment by working from the *absolute magnitudes* of the unemployment percentages.[2] The writer, in proposing to the President's Conference on Unemployment the use of the adjusted indexes as a rough check on estimates of unemployment[3]—such as the special "unemployment surveys"—regarded this use as a mere by-product of the index method, the results of which must be interpreted cautiously. Others who have subsequently used the results have sometimes overrated their accuracy. Though pointing out the presence of a large probable error in the unemployment estimate based on the index, the writer believes that the errors introduced by using the actual percentages of unemployed are probably far greater. The entire problem of estimating the volume of unemployment cannot be solved satisfactorily in the present state of knowledge. It is probably unsafe to judge whether the problem is even determinate or not until the isolation of seasonal, cyclical, and other factors in the problem has been completely presented. When this has been done, a thorough critique of the recent unemployment estimates will be presented.

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[1] Arthur L. Bowley, *Elementary Manual of Statistics*, 3d ed., 1920, p. 155.

[2] This other method of attack is typified by Mr. E. S. Bradford's work on the subject. See "Methods of Measuring Unemployment," *Quart. Pub. of the Amer. Stat. Ass'n.*, Vol. XVII, pp. 983–94, Dec., 1921.

[3] Harvard Economic Service, *Special Letter on Industrial Employment*, Oct. 8, 1921, p. 6; also *Report of the President's Conference on Unemployment*, 1921, pp. 52–56.

# THE BUYING POWER OF LABOR DURING THE WAR

By Alvin H. Hansen, *University of Minnesota*

During the war it was the general opinion that the wage-earning class was spending money more freely and living more extravagantly than in the pre-war days. This popular belief would imply that the buying power of labor as a class had increased, that their money incomes had risen faster than retail prices and the cost of living. In answer to this wide-spread current opinion statistics have often been adduced to show that wage rates lagged behind the cost of living. But wage rates do not tell the story of working-class incomes. Because wage rates lagged behind the cost of living it by no means follows that the buying power of the wage-earning class decreased.

In considering the buying power of the wage-earning population we are concerned with total earnings, not with wage rates. Wage rates, of course, affect earnings, but there are many other factors of equal importance such as (1) short-time or over-time, (2) over-time bonuses, (3) steady employment of members of the wage-earning class normally employed, and (4) employment of members of the wage-earning population not normally working. The total wages paid in industrial establishments takes account of all these factors. Pay-rolls, not wage rates, are an index of the buying power of the wage-earning class.

A full discussion of the buying power of the wage-earning class during the war must involve a consideration of the following points: (1) changes in the total wages received; (2) changes in the purchasing power of the dollar; (3) increase in the wage-earning population; (4) withdrawal of men and boys into the army and the navy; (5) effect of this withdrawal upon the per capita consumption needs of the remaining population; (6) influx of agriculturalists into industrial work; and (7) determination of normal working-class buying power in order to ascertain whether or not the buying power of this group was above or below normal during the war.

The following study is based on the data furnished by the *Labor Market Bulletins* of New York State and the reports on "Employment in Selected Industries" published each month in the *Monthly Labor Review* of the United States Bureau of Labor Statistics. The New York data cover 55 industries. Reports are received from representative firms in each of these industries, and the firms reporting employ approximately one third of all the employees engaged in manufacturing in New York State.[1] The data furnished by the United States Bureau of Labor Statistics cover representative firms in 13 manufacturing industries in various parts of the country. These 13 industries employ slightly more than one third of all the persons engaged in manufacturing in the United States. The representative firms from these 13 industries which report to the Bureau of Labor Statistics employ nearly one tenth of all the persons engaged in manufacturing in the United States.

The data furnished by these two bureaus may safely be taken to represent conditions for the industrial wage-earning population. With regard to the New York data the Harvard Committee of Economic Research has this to say: "According to an investigation recently completed for the Committee on Economic Research, employment conditions in New York reflect with great accuracy those in the entire industrial section of the United States."[2] This is borne out by the closeness with which the New York data parallel the data of the United States Bureau which cover a widespread area, in fact most of the important industrial states of the union.

Table I gives the index numbers for total wages paid in representative factories in New York State and in the United States. The New York index numbers were constructed from the relatives given for each month in *Special Bulletin No. 85* for the years 1914–16, and in each issue of the *Labor Market Bulletin* for the remaining period. The United States relatives are a simple average of the index numbers of total wages paid in each of the 13 industries.[3] The base for the New York figures is June, 1914. The base for the figures for the United States as given in the *Monthly Review* is January, 1916. The United States relatives were made comparable to the New York figures through the medium of the New York index number for January, 1916, which was 116. Each of the United States figures was multiplied by 1.16 on the assumption that the United States figures had risen approximately as high by January, 1916, as had the New York figures. The remarkable closeness with which the two series parallel each other throughout 1916–20 would warrant this assumption.

The index numbers of total wages paid, however, serve merely as a starting point for our discussion. They tell us nothing about the real buying power of the wage-earning population during the war. The enormous increase in the amount of the pay-roll was largely due to the depreciation of the dollar. Inasmuch as we are interested in the buying power of the wage-earning class this depreciation should be measured in terms of the retail prices of the things that go into the wage-earners' budget. In short, for our purposes the depreciation of the dollar may properly be measured by the changes in the cost of living. The index numbers of cost of living given in Table I were constructed from data appearing in the *Monthly Labor Review* for October, 1919, and July, 1921. The changes in the cost of living as quoted in the *Review* are for June and December of each year. From these figures the mean for the first and the last half of each year was calculated. An average of these two figures for each year was then taken. This would give the average cost of living for the year.

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[1] See *Special Bulletin No. 85*, Bureau of Statistics and Information, Department of Labor, New York State.

[2] Special Letter, October 8, 1921, on "Industrial Employment," p. 3.

[3] The *Monthly Labor Review* for May, 1919, pp. 186–7, gives the index numbers for all the industries from January, 1916, to March, 1919, and for seven industries for each of the months of 1915. Index numbers for the remaining period were worked up from the original data published in each *Monthly Review*.

TABLE I

| Year | Total wages paid (June, 1914=100) | | Cost of living (1914=100) | Total wages paid in terms of 1914 prices (June, 1914=100) | |
|---|---|---|---|---|---|
| | New York State | United States | | New York State | United States |
| 1915............ | 100.7 | 101.6 | 102.3 | 98.4 | 99.3 |
| 1916............ | 131.2 | 131.3 | 109.5 | 119.8 | 119.9 |
| 1917............ | 156.2 | 159.2 | 129.0 | 121.1 | 123.4 |
| 1918............ | 197.0 | 196.5 | 156.3 | 126.0 | 125.8 |
| 1919............ | 212.7 | 222.1 | 179.4 | 118.6 | 123.8 |
| 1920............ | 263.5 | 263.3 | 205.1 | 128.5 | 128.4 |

We are not greatly interested, however, in the total buying power of the wage-earning class as a whole, because that would naturally increase with the growth of population, and such an increase would in no way indicate any improvement in the economic condition of labor. We wish rather to know the changes in the per capita buying power. We are referring here to the buying power of each member of the wage-earning population including those not gainfully employed. If, for example, the wage-earning population increased 10 per cent while the total buying power also increased 10 per cent, there would have been no change in the per capita buying power. We must therefore take account of the continuous increase in the wage-earning population.

According to the preliminary data of the Census Bureau the gainfully employed persons in the United States increased from 38,167,336 in 1910 to 41,609,192 in 1920, an increase of 9 per cent. The total population, however, increased 14.9 per cent. The greater increase of the total population implies a decrease in the proportion of the population gainfully employed. This decrease points to an improved standard, since, among other things, it indicates less child labor. It is not likely that this development has been more marked in the industrial wage-earning group than in the other economic groups, since child labor had already been greatly reduced, especially in the northern states, by 1910. With the development of higher educational standards, particularly in the rural districts, the tendency has probably been at least as marked among farmers, small independent proprietors, and the lower salaried people. So far as the professional classes are concerned, standards have been raised and the age of admission is higher. In the absence of accurate information we will assume that the proportionate increase of the total industrial wage-earning population as compared to the increase of the industrial wage-earners gainfully employed was the same as obtained for the population generally. According to an estimate of the Harvard Committee on Economic Research based on preliminary data of the Census Bureau, the persons employed in manufacturing and mechanical pursuits in 1920 were approximately 12,000,000.[1] This would amount to an increase of 12.6 per cent over 1910. Applying the proportion referred to above, we conclude that if the total gainfully employed increased 9 per cent while the total population increased 14.9 per cent, the manufacturing population must have increased 21 per cent, since the persons employed in manufacturing increased 12.6 per cent. Since the data used in this study are concerned with manufacturing industries, we may properly assume that the industrial wage-earning population, in the sense in which we are here using the term, increased 21 per cent from 1910 to 1920. The index numbers given in Table II are constructed on this basis. Because of the increasing industrialization of the country it seems reasonable that the wage-earning population should increase more than the population generally.

TABLE II

(June, 1914=100)

| Year | Industrial wage-earning population | Per capita buying power New York State | Per capita buying power United States |
|---|---|---|---|
| 1915 | 101.7 | 96.8 | 97.6 |
| 1916 | 103.4 | 115.9 | 116.0 |
| 1917 | 105.2 | 115.1 | 117.3 |
| 1918 | 106.9 | 117.9 | 117.7 |
| 1919 | 108.7 | 109.1 | 113.9 |
| 1920 | 110.4 | 116.4 | 116.3 |

The total amount of real wages received by the wage-earning population may now be reduced to a per capita basis by dividing the index numbers of total wages paid (in terms of 1914 prices) by the index numbers of the wage-earning population for the corresponding years. The result appears in Table II.

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[1] Special letter, p. 6.

Still other factors must be taken into account. A large number of men and boys from all walks of life were drawn away from productive activity into the service of the army and the navy during the years 1917–19. The inductions into the army and the navy and subsequent withdrawals during the years 1917–19 constitute an average loss from productive life for each year as follows:[1]

| Year | Number in service |
|---|---|
| 1917 | 414,583 |
| 1918 | 2,604,000 |
| 1919 | 1,334,833 |

The average for the three years is 1,451,139. This amounts to 1.4 per cent of the entire population. The draft presumably affected all classes of the population alike. We may, then, assume that the wage-earning population was reduced 1.4 per cent on the average for the three years 1917–19, and that the per capita buying power was, therefore, 1.4 per cent greater than would have been the case had this military population had to be supported out of the wages actually received in industrial establishments during those three years. This is, however, on the assumption that the males who entered the service were "average" individuals in a normal population. This assumption is, of course, not sound, and the above figure, therefore, needs to be corrected. The withdrawal of a large number of adult males appreciably affected the structure of the remaining population as to sex and age distribution. Since the consumption needs vary greatly with sex and age, that factor must be taken into account. This necessitates a study of the normal structure of the population, and a comparison of the consumption needs of an "average" individual in a normally constituted population with the consumption needs of the average male inducted into the service. In 1910 the age distribution of the population in the United States was as follows:[2]

TABLE III

| Ages | Per cent of population | Consumption needs in terms of "ammains"[a] |
|---|---|---|
| Under 5 years | 11.6 | 0.261 |
| 5 to 14 " | 20.5 | 0.448 |
| 15 to 24 " | 19.7 | 0.874 |
| 25 to 44 " | 29.1 | 0.855 |
| 45 to 64 " | 14.6 | 0.767 |
| Over 64 " | 4.3 | 0.692 |

[a] Sydenstricker and King, "The Measurement of the Relative Economic Status of Families," *Quart. Pub. of the Amer. Stat. Ass'n.*, Sept., 1921, p. 854.

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[1] "Annual Report of the Secretary of War," 1919; *Statistical Abstract* for 1919 and 1920.

[2] *Census of 1910*, "Population," Vol. I.

The last column of the above table shows the consumption needs of each age group in terms of "ammains." An ammain represents the consumption needs of an adult male at the age when his consumption needs are the greatest. The ammain figure for each age group in the table above is the median for that age group as given by Sydenstricker and King, the median figure for males and females being averaged for each group. From the above table the weighted averaged consumption needs of a normal population in terms of ammains was computed. This figure was found to be 0.686. The average consumption needs of the men inducted into the service was next computed. The ages ranged from 18 to 29 inclusive. The simple average of the ammains for these ages was found to be 0.982. It therefore appears that the average consumption needs of the men entering the service was the equivalent of 1.432 times the average consumption needs of the population generally. The effect of the induction of these men into the service was therefore 1.432 times greater than their actual number would indicate. The withdrawal of 1,451,139 adult males had the same effect on the consumption needs of the population as though 2,078,031 "average" individuals or 2 per cent of the population had been withdrawn. We may conclude, then, that the per capita buying power in 1917–19 was 2 per cent greater than would have been the case had the industrial wage-earners inducted into the service had to be supported out of the wages actually received during these years.

In the foregoing discussion it has been assumed that the changes in total wages paid in the representative factories were due entirely to the following variables: (1) changes in wage rates; and (2) changes in employment due to (a) over-time, (b) increased employment of industrial wage-earners normally working, and (c) employment of members of industrial families not normally working. As a matter of fact this is not entirely true. Another variable was the influx of agricultural laborers into industrial work. There is no accurate information as to the extent of this influx. Hornell Hart[1] says that at the peak of the demand for labor in 1917 probably over a million agricultural laborers were absorbed in industry. That would mean, according to his figures, an addition of 3.3 per cent to the supply of urban workers. But the influx amounted to little or nothing at the beginning of 1917, and there was a back flow toward the end of the year. The average addition for the entire year must certainly have been less than 2 per cent of the wage-earners gainfully employed. For the years 1918 and 1919, with the competing high wages for farm labor, it is likely that the percentage was at least no higher. At the most, then, we should not discount the 1917–19 figures given in Table II by more than 2 per cent because of this influx of agricultural labor.

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[1] *Fluctuations in Unemployment in Cities of the United States, 1902 to 1917.* Helen S. Trounstine Foundation, Cinninnati.

The gain accruing from the reduction of the wage-earning population during the war years was probably offset, therefore, by the fact that a portion of the wages which we have assumed were received by the regular industrial wage-earning population was really received by the agriculturalists temporarily engaged in industrial work.

So far we have been discussing the purchasing power of the industrial wage-earning class during the war years as compared to June, 1914. But June, 1914, was a period of deep depression, of great unemployment, and, in all probability, of a considerable amount of short-time work. The purchasing power of labor in June, 1914, was therefore very much below normal. What we really want to know is this: Was the purchasing power of labor during the war years above or below normal? In order to answer this question we must find a normal base. June, 1914, is not a normal base.

Ordinarily, the way to find a normal base would be to take an average for a number of years prior to the war which would include one or more complete waves of the business cycle. That method, however, is impossible in this case because we do not have the pre-war data. The New York figures start with June, 1914, and the figures for the United States start with January, 1915. The writer therefore sought to get at the problem by asking the question: How far was June, 1914, below normal? If it was 10 per cent below normal, obviously the index number for June, 1914, should stand at 90 instead of at 100, and the index numbers given in the tables above should be correspondingly reduced. The problem was to ascertain how far June, 1914, was below normal as to total wages paid. Since in pre-war times wage rates were not altered greatly by short periods of depression, substantially the only thing that did appreciably effect the total wages paid in June, 1914, was the condition of employment. Unemployment and short-time work reduced the total wages paid. The condition of employment can, in turn, be measured by industrial conditions generally. How far were industrial conditions generally below normal in June, 1914?

I have taken three indexes of industrial conditions in order to determine how far the year 1914 was below normal. They were as follows: (1) the index of production of manufactures, 1902–16,[1] (2) percentage of employment in cities in the United States, 1902–16,[2] and (3) railroad gross earnings, 1902–16.[1] The period 1902 to 1916 includes four waves of the business cycle. The period starts and ends with business on the upward swing.

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[1] E. E. Day, "The Measurement of Variations in the National Real Income." *Quart. Pub. of the Amer. Stat. Ass'n.*, March, 1921, p. 555.

[2] Hart, *op. cit.*, Vol. I, No. 2, p. 48.

It was assumed that the secular trend or the line of regression for each curve would indicate the normal condition for any year. The average for the entire period would certainly not indicate the normal condition for any one year such as 1914, for example, since a marked trend appears in each case with the single exception of employment. In the case of employment there is no marked trend owing to the fact that the figures are the percentage of the total available supply of labor employed in each year. Since there is no trend in this case, the simple average for the entire period gives very nearly the same result as the secular trend. The average percentage of employment for the entire 15 years is 89.7, while the secular trend shows a percentage for 1914 of 89.2.

The line of regression was found by the method of moments, the following simultaneous equations being used to find $m$ and $b$:

$$\Sigma y = m\Sigma x + nb$$
$$\Sigma xy = m\Sigma x^2 + \Sigma xb.$$

The line of regression was then found by substituting the values found for $m$ and $b$ in the equation $y = mx + b$. The figures for $y$ for each year would give us the secular trend, and the values for $y$ for the year 1914 would give us the normal which we are seeking to establish. Table IV compares the values for $y$ for 1914 with the actual figures for that year.

TABLE IV

| Item | Actual figure for 1914 | $y$, or normal for 1914 | Degree to which 1914 was normal |
|---|---|---|---|
| Production (1899=100) | 171.4 | 187.47 | 91.4% |
| Employment (per cent of supply employed) | 84.2 | 89.25 | 94.3% |
| Railroad gross earnings (per mile) | 12.3 | 13.14 | 93.6% |

Taking a simple average of the three indexes of industrial conditions we find, then, that 1914 was 93 per cent normal, or 7 per cent below normal. No doubt the employment index understates the extent to which the year was subnormal. This is due to the fact that a slack period in production shows itself not only in unemployment, but also in short-time. However, the average would have been but slightly lower if the employment index had been omitted.

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[1] Reports of the Interstate Commerce Commission.

It thus appears that the year 1914 was approximately 7 per cent below normal. The single month of June, 1914, however, is the base for the figures used in this study. It becomes necessary, therefore, to determine to what extent this particular month was below normal. Monthly figures for production are not available, and the monthly figures for railroad gross earnings are useless because of the tremendous seasonal fluctuations to which they are subject. Certain facts may be adduced, however, to show that industrial conditions in June, 1914, were approximately similar to conditions obtaining on the average for the year 1914. Take, for example, the percentage of employment according to Hart's figures. In June, 1914, 84.6 per cent of the available supply of labor was employed, while the average for the year was 84.2 per cent. Production of pig iron for June was 1,918,000 tons, while the average for the year was 1,921,000 tons.[1] Industrial conditions for June were not only average, they were also median. Depression, it appears, was somewhat greater during the last half of the year than had been true of the first five months of the year. The average monthly production of pig iron from January to May was 322,000 tons in excess of the average monthly production from July to December. The percentage of employment averaged 84.8 from January to May, while the average was 83.4 from July to December. It seems reasonable to suppose that the index number representing industrial conditions for June, 1914, would not differ materially from the index number representing industrial conditions for the year 1914 as a whole.

From the above discussion it is clear that index numbers based on June, 1914, give an exaggerated impression of the increase in the buying power of labor during the war period. June, 1914, as well as the year 1914 as a whole, was about 7 per cent below normal in production and in employment, including short-time. It follows that the current buying power of labor in June, 1914, was probably about 7 per cent below normal. The buying power index numbers given in Table II should therefore be reduced 7 per cent. This has been done in Table V,

TABLE V

PER CAPITA BUYING POWER OF LABOR, 1915–20

(100=Normal)

| Year | New York State | United States |
|---|---|---|
| 1915 | 90.0 | 90.8 |
| 1916 | 107.8 | 107.9 |
| 1917 | 107.0 | 109.1 |
| 1918 | 109.6 | 109.5 |
| 1919 | 101.5 | 105.9 |
| 1920 | 108.3 | 108.2 |

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[1] Babson's Statistical Tables and Charts.

which gives, as nearly as can be ascertained, the extent to which the per capita buying power of the wage-earning population varied from normal during the years 1915–20.

The per capita buying power of the wage-earning class during the years 1916–18 appears, then, to have been on the average 8.5 per cent above the normal per capita buying power of labor in pre-war days. How can this be accounted for in view of the apparent actual decrease in real wage rates shown, for example, by Mr. Douglas and Miss Lamberson for the years 1915–18?[1] In answer to this question the writer would suggest two points:

1. The decrease in real wage rates shown in the study referred to above is probably somewhat exaggerated so far as the years 1916–18 are concerned. The study consists mainly of union wage scales. The figures therefore correspond closely to the index numbers of union wage rates given in *Bulletin No. 286* of the Bureau of Labor Statistics, p. 21. There can be little doubt that union wage scales lagged considerably behind the actual wage rates paid generally. A more comprehensive study of wage rates for the war period is needed. But while further study may show that the decline in wage rates in terms of purchasing power was not quite so great as the above-mentioned investigation would indicate, the broad conclusion that real wage rates declined up to and including 1918 is likely to be sustained. Mr. Douglas suggests[2] that wage rates probably caught up with the cost of living by 1919.

2. Even though wage rates lagged behind the cost of living during 1915–18, the increase in the per capita buying power of labor during the war years can readily be explained by over-time and over-time bonuses, full employment for those regularly working, and the employment of members of the family not normally working.

Take the matter of over-time. Mr. Douglas says that he is "still in doubt as to whether the purchasing power of actual weekly earnings including over-time increased or decreased during that time," *i. e.*, up to and including 1918. This study would indicate that average weekly earnings including over-time did actually keep pace with the cost of living.

Consider now the employment of members of the family not normally working. The following table indicates the extent of that excess employment over and above what appears to have been normal during the pre-war period. It will be remembered that the percentage of the total available supply of labor employed in 1914 was 5.7 per cent below normal. The original index numbers were correspondingly reduced so that the figures given below show the variations from normal. The original index numbers were first reduced to a per capita basis by dividing them by the index numbers of the industrial population, and then reduced to the pre-war normal base as indicated above. The table therefore indicates the extent to which per capita employment was above or below the normal pre-war level.

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[1] Paul H. Douglas and Frances Lamberson, "The Movement of Real Wages 1890–1918," *Amer. Economic Rev.*, Sept., 1921, pp. 409–426.

[2] "An Examination of the Wage Statistics of the National Industrial Conference Board," *Quart. Pub. of the Amer. Stat. Ass'n.*, Sept., 1921, pp. 893–904.

The original figures were for "total employees" as given in the *Labor Market Bulletins* of New York State, and "number on pay-roll" as given in the *Monthly Review*. The index numbers for the United States were constructed by summating the "number on pay-roll" for all the 13 industries.

TABLE VI

INDEX NUMBERS OF PER CAPITA EMPLOYMENT, 1915–20

(100=Normal)[1]

| Year | New York State | United States |
|---|---|---|
| 1915 | 91.2 | 92.3 |
| 1916 | 104.2 | 102.5 |
| 1917 | 107.6 | 106.4 |
| 1918 | 107.4 | 104.8 |
| 1919 | 98.7 | 97.0 |
| 1920 | 100.8 | 97.6 |

If the index numbers for per capita buying power are compared with the index numbers for per capita employment, it will appear that a large part of the excess per capita buying power of the wage-earning population during the war years was due to the employment of members of industrial families not normally working. Since there was in addition considerable over-time, it appears reasonable that real wage rates decreased from 1915 to 1918 as Mr. Douglas and Miss Lamberson show. It will be noticed on the other hand that in spite of the decline in employment in 1919 and 1920 a considerable excess buying power is indicated for these years, especially for 1920. Since over-time could not have been an important item for these years, wage rates must have overtaken the cost of living.

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[1] It should be noted that this table is intended to show how much of the increased buying power of labor during the war years was due to an excess of employment over what appeared to be normal *before the war*. It does not show the extent to which employment was in excess of normal *for each particular year*. The reason for this is that the proportion of the population gainfully employed declined during the period under consideration. A table showing the extent to which employment was above or below normal in each of the years 1915–20 should be constructed by dividing the index numbers for the total number on the pay-roll by the index numbers showing the normal increase in persons gainfully employed in manufacturing, and not by the index numbers showing the increase in the manufacturing population. The following table is appended to show the extent to which employment was in excess of what could properly be considered normal for each year in view of the decline in the proportion of the total manufacturing population which was gainfully employed.

| Year | New York State | United States |
|---|---|---|
| 1915 | 91.8 | 93.0 |
| 1916 | 105.6 | 103.8 |
| 1917 | 109.7 | 108.4 |
| 1918 | 110.2 | 107.5 |
| 1919 | 101.9 | 100.2 |
| 1920 | 104.7 | 101.4 |

# INCOME FLUCTUATION OF A SELECTED GROUP OF PERSONAL RETURNS

By Edward White, *Bureau of Internal Revenue*

From time to time statements appear in the press purporting to show the number of millionaires in the United States. The figures used are generally credited to tables appearing in *Statistics of Income*, compiled annually from the returns of net income filed with the United States Bureau of Internal Revenue.

There are, in fact, no tables published in *Statistics of Income* showing the wealth of individuals, nor the number falling in the category of the millionaire class, according to capital possessions. What the tables actually show, among other data, is the number of persons filing income tax returns, segregated by income classes according to the size of net income reported. It would appear, therefore, that such statements as to the number of millionaires in the United States, claiming the Reports of the Commissioner of Internal Revenue as the source of information, are based on theoretical capitalizations of the income reported in the returns. Thus, all persons reporting net income in excess of $50,000 are classed as millionaires, if the extension is made on the basis of a 5 per cent return on capital. Such deduction is predicated on the assumption that all incomes are derived from invested funds.

It is surprising that results obtained by such reasoning should be accepted seriously, or should be repeated by a thoughtful person. Not only do the returns report normal incomes from investments and personal service, but they likewise contain the spectacular incomes from fortunate business and speculative ventures; large fees and commissions; unusual distribution of corporate earnings; profits arising from discovery and sale of natural resources; proceeds from sales of inventions, etc. And conversely, although individual incomes in one or more years may be very large, influenced by the above conditions, in succeeding years, due to adverse circumstances, they may fall in like proportion or even be wiped out entirely.

The accompanying tables are taken from the Report of the Commissioner of Internal Revenue, issued under the title, *Statistics of Income*, compiled from the returns for 1919.

Table A shows the total number of personal returns of net income filed for the years 1914–19 inclusive, segregated by income classes.

It would be interesting if we could see beneath the figures the changes in fortune of each of the individuals from year to year—how many remain constant in a given income class, how many rise from the lowest even to among the highest, and how many drop from the very high classes to insignificance. The casual reader may jump to the conclusion that returns, certainly in the higher income classes, are filed by the same people from year to year, with the exception that in some years there are a few more and some years a few less. How erroneous this conception is, is clearly shown by the fact that of the 1,240 individuals that reported net incomes of $300,000 and over in one or more of the years 1914–1919 inclusive, only 137 or 11 per cent reported that amount in all of the years.

TABLE A

NUMBER OF PERSONAL RETURNS, CALENDAR YEARS 1914–19, BY INCOME CLASSES

| Income class | 1914 | 1915 | 1916 | 1917 | 1918 | 1919 |
|---|---|---|---|---|---|---|
| $1,000 to $2,000 | ...... | ...... | ...... | 1,640,758 | 1,516,938 | 1,924,872 |
| 2,000 " 3,000 | ...... | ...... | ...... | 838,707 | 1,496,878 | 1,569,741 |
| 3,000 " 4,000 | 82,754 | 69,045 | 85,122 | 374,958 | 610,095 | 742,334 |
| 4,000 " 5,000 | 66,525 | 58,949 | 72,027 | 185,805 | 322,241 | 438,154 |
| 5,000 " 10,000 | 127,448 | 120,402 | 150,553 | 270,666 | 319,356 | 438,851 |
| 10,000 " 15,000 | 34,141 | 34,102 | 45,309 | 65,800 | 69,992 | 97,852 |
| 15,000 " 20,000 | 15,790 | 16,475 | 22,618 | 29,896 | 30,227 | 42,028 |
| 20,000 " 25,000 | 8,672 | 9,707 | 12,953 | 16,806 | 16,350 | 22,605 |
| 25,000 " 30,000 | 5,483 | 6,196 | 8,055 | 10,571 | 10,206 | 13,769 |
| 30,000 " 40,000 | 6,008 | 7,005 | 10,068 | 12,733 | 11,887 | 15,410 |
| 40,000 " 50,000 | 3,185 | 4,100 | 5,611 | 7,087 | 6,449 | 8,298 |
| 50,000 " 100,000 | 5,161 | 6,847 | 10,452 | 12,439 | 9,996 | 13,320 |
| 100,000 " 150,000 | 1,189 | 1,793 | 2,900 | 3,302 | 2,358 | 2,983 |
| 150,000 " 200,000 | 406 | 724 | 1,284 | 1,302 | 866 | 1,092 |
| 200,000 " 250,000 | 233 | 386 | 726 | 703 | 401 | 522 |
| 250,000 " 300,000 | 130 | 216 | 427 | 342 | 247 | 250 |
| 300,000 " 400,000 | 147 | 254 | 469 | 380 | 260 | 285 |
| 400,000 " 500,000 | 69 | 122 | 245 | 179 | 122 | 140 |
| 500,000 " 1,000,000 | 114 | 209 | 376 | 315 | 178 | 189 |
| 1,000,000 and over | 60 | 120 | 206 | 141 | 67 | 65 |
| Total | 357,515 | 336,652 | 429,401 | 3,472,890 | 4,425,114 | 5,332,760 |
| Married women making separate returns from husbands | ...... | ...... | 7,635[1] | ...... | ...... | ...... |
| Total number of returns filed | 357,515 | 336,652 | 437,036 | 3,472,890 | 4,425,114 | 5,332,760 |

[1] In 1916 the net incomes on returns filed separately by husband and wife are combined and the total appears as one return. In all other years the returns of married women, filed separately, are included in their individual income classes independently of the husband's return.

The extent to which a group of returns falling in specific income classes in one year may be spread throughout the range of income classes in succeeding years, is illustrated in the following tables, which show the income class dispersion of a given group of individuals from year to year, as well as the changes in the nature of the income reported.

During the period 1914–19 inclusive there were 1,636 persons who in one or more of those years reported net incomes of $300,000 and over. Of this group there were 1,240 whose returns for each of the years were

TABLE 1.

NET INCOME REPORTED FOR EACH YEAR, BY THE SAME INDIVIDUALS, GROUPED ACCORDING TO SIZE OF NET INCOME FOR 1914. RETURNS OF 1,240 PERSONS, EACH OF WHOM REPORTED NET INCOME OF $300,000 AND OVER IN ONE OR MORE YEARS 1914–1919.

| Income Class. Distribution, based on 1914 returns. | Number. | 1914 Net income. | 1915 Net income. | 1916 Net income. | 1917 Net income. | 1918 Net income. | 1919 Net income. |
|---|---|---|---|---|---|---|---|
| Reporting deficit....... | 23 | $ 1.571.606* | $ 6,826,760 | $ 9,744,520 | $ 7,077,661 | $ 4,549,731 | $ 6,235,946 |
| Under $ 10,000 | 59 | 380,562 | 6,637,571 | 14,594,795 | 18,004,040 | 11,553,497 | 14,459,673 |
| $ 10,000 to 25,000 | 104 | 1,765,378 | 10,051,848 | 53,723,930 | 31,442,170 | 20,740,166 | 25,763,641 |
| 25,000 " 50,000 | 156 | 5,913,947 | 28,516,024 | 46,919,002 | 49,885,564 | 34,864,551 | 40,092,640 |
| 50,000 " 100,000 | 219 | 16,063,020 | 46,934,813 | 74,923,249 | 76,145,778 | 60,527,938 | 56,077,052 |
| 100,000 " 150,000 | 150 | 18,495,835 | 37,724,640 | 69,362,791 | 56,504,854 | 49,277,361 | 42,176,446 |
| 150,000 " 200,000 | 102 | 17,792,202 | 28,967,368 | 43,538,255 | 43,034,551 | 36,942,421 | 31,441,777 |
| 200,000 " 250,000 | 79 | 17,971,504 | 34,833.435 | 45,339,238 | 38,366,944 | 26,079,026 | 19,957,634 |
| 250,000 " 300.000 | 57 | 15,381,653 | 19,572,049 | 34,288,857 | 27,783,994 | 20,994,805 | 19,080,050 |
| 300,000 " 400,000 | 98 | 33,895,936 | 82,339,024 | 76,594,383 | 56,569,777 | 41,297,606 | 41,496,480 |
| 400,000 " 500,000 | 46 | 20,526,125 | 26,039,548 | 35,275,617 | 25,602,362 | 19,054,701 | 17,915,913 |
| 500,000 " 750,000 | 69 | 42,050,577 | 48,561,952 | 61,353,540 | 51,117,232 | 38,977,793 | 33,033,733 |
| 750,000 " 1,000,000 | 21 | 18,263,309 | 22,985,455 | 35,632,743 | 23,916,177 | 14,891,302 | 13,197,398 |
| 1,000,000 " 1,500,000 | 26 | 31,270,554 | 37,980,986 | 53,154,947 | 49,398,349 | 27,231,152 | 33,085,538 |
| 1,500,000 " 2,000,000 | 16 | 27,446,872 | 28,277,780 | 33,540,057 | 31,828,788 | 21,568,941 | 18,887,454 |
| 2,000.000 " 3,000,000 | 8 | 18,899.957 | 19,570,852 | 20,304,460 | 15,288,740 | 12,060,196 | 10,227,410 |
| 3,000,000 and over.... | 7 | 49,326,108 | 49,824,450 | 57,127,723 | 53,350,714 | 35,774,294 | 37,228,711 |
| Total.......... | 1.240 | 333,871,933 | 535,444,555 | 765,418,107 | 655,317,695 | 476,385,481 | 460,357,496 |

*Deficit.

available. The returns of the remaining 396 persons either were not available or could not be included in the tabulation for the following reasons: some were for estates which terminated during this period; others were not comparable for the entire period, as in some years the returns contained the incomes of several members of the same family while in other years separate returns were filed for each member; and still others were not procurable for one or more of the years owing to the fact that their incomes were under the minimum required by the law to be reported.

The term "person" or "individual" as used herein should be understood to signify not only returns filed by individuals, but also joint returns of husband and wife, or family, as well as incomes of estates or trusts.

The tables cover the years of the Great War, as well as 1919. During this period incomes were affected more violently because of the unprecedented economic upheaval than is general in normal times. However, some of the incomes that show the greatest variation were the result of causes other than conditions superinduced by the war.

It has been said that incomes in the United States fluctuate more widely from year to year than in any other country in the world. Certainly the tables give some spectacular evidences of Fortune's favor. Among the many remarkable cases of income expansion is the group of 23 persons, each of whom for the year 1914 reported deficit, whereas, in 1916, 1 reported a net income exceeding one million dollars, and 9 reported incomes between $500,000 and $1,000,000.

In the group of 59 persons reporting in 1914 net incomes not exceeding $10,000, 5 reported in 1916 net incomes in excess of one million dollars each. Still more spectacular is the group of 104 persons who in 1914 reported between $10,000 and $25,000; in 1916, 4 reported in aggregate over $27,000,000; 1 between $1,500,000 and $2,000,000; 2 between $1,000,000 and $1,500,000; and 10 between $500,000 and $1,000,000.

Of the group of 156 persons who in 1914 had incomes between $25,000 and $50,000, 1 in 1917 reported between $2,000,000 and $3,000,000; 3 between $1,500,000 and $2,000,000; 3 between $1,000,000 and $1,500,000, and 10 between $500,000 and $1,000,000. Of the 219 persons who in 1914 reported between $50,000 and $100,000, 1 in each of the years 1915, 1916, and 1917 reported over $2,000,000; 2 in 1915, 1 in 1916, 2 in 1917, and 1 in 1918 reported between $1,500,000 and $2,000,000; and reporting between $1,000,000 and $1,500,000 were 4 in 1915, 6 in 1916, 1 in 1917, 1 in 1918, and 3 in 1919.

Of the 150 persons reporting in 1914 incomes between $100,000 and $150,000, 2 reported in 1916 incomes between $2,000,000 and

### TABLE B.

NET INCOME REPORTED FOR EACH YEAR, BY THE SAME INDIVIDUALS, GROUPED ACCORDING TO THE SIZE OF NET INCOME FOR 1914.

RETURNS OF 1,240 PERSONS, EACH OF WHOM REPORTED NET INCOME OF $300,000 AND OVER IN ONE OR MORE YEARS 1914–19.

| Income class Distribution based on 1914 returns | Number | 1914 | 1915 | 1916 | 1917 | 1918 | 1919 |
|---|---|---|---|---|---|---|---|
| | | Net income | Net income | Net income | Net income | Net income | Net income |
| Under $100,000 | 561 | $22,551,301 | $98,967,016 | $199,905,496 | $182,555,213 | $132,235,883 | $142,628,952 |
| $100,000 to 300,000 | 388 | 69,641,194 | 121,097,492 | 192,529,141 | 165,690,343 | 133,293,613 | 112,655,907 |
| 300,000 to 1,000,000 | 234 | 114,735,947 | 179,925,979 | 208,856,283 | 157,205,548 | 114,221,402 | 105,643,524 |
| 1,000,000 and over | 57 | 126,943,491 | 135,454,068 | 164,127,187 | 149,866,591 | 96,634,583 | 99,429,113 |
| Total | 1,240 | $333,871,933 | $535,444,555 | $765,418,107 | $555,317,695 | $476,385,481 | $460,357,496 |

### TABLE H.

NET INCOME REPORTED FOR EACH YEAR, BY THE SAME INDIVIDUALS, GROUPED ACCORDING TO SIZE OF NET INCOME FOR 1919.

RETURNS OF 1,240 PERSONS, EACH OF WHOM REPORTED NET INCOME OF $300,000 AND OVER IN ONE OR MORE YEARS 1914–19.

| Income class Distribution based on 1919 returns | Number | 1914 | 1915 | 1916 | 1917 | 1918 | 1919 |
|---|---|---|---|---|---|---|---|
| | | Net income | Net income | Net income | Net income | Net income | Net income |
| Under $100,000 | 264 | $47,087,237 | $88,579,164 | $157,879,193 | $116,804,298 | $52,691,468 | $6,237,379 |
| $100,000 to 300,000 | 437 | 80,165,266 | 132,638,690 | 225,038,177 | 182,315,433 | 124,489,895 | 82,866,550 |
| 300,000 to 1,000,000 | 483 | 127,457,552 | 187,720,470 | 257,856,718 | 232,579,831 | 207,596,729 | 229,600,304 |
| 1,000,000 and over | 56 | 79,161,878 | 126,506,231 | 124,644,019 | 123,618,133 | 91,607,389 | 141,653,263 |
| Total | 1,240 | $333,871,933 | $535,444,555 | $765,418,107 | $655,317,695 | $476,385,481 | $460,357,496 |

TABLE 2.

NET INCOME AND INCOME BY SOURCES REPORTED EACH YEAR BY THE SAME INDIVIDUALS, GROUPED ACCORDING TO SIZE OF NET INCOME FOR 1914.

RETURNS OF 1,240 PERSONS, EACH OF WHOM REPORTED NET INCOME OF $300,000 AND OVER IN ONE OR MORE YEARS 1914–1919.

| Income class<br>Distribution, based on 1914 returns. | Number | Year | Net income. | Sources of income. | | | | | Miscellaneous deductions. | Total Tax. | Net income after deducting tax. | Per cent of tax to net income |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Salaries, Commissions, Fees, etc. | Business and profits from sales of real estate, stocks bonds, etc. | Rents and royalties. | Dividends. | Interest. | | | | |
| Under $100,000 | 561 | 1914 | 22,551,301 | $ 4,808,118 | $ 11,553,455 | $ 1,177,013 | $ 11,081,630 | $ 4,330,976 | $10,399,891 | $ 339,784 | $ 22,211,517 | 1.51 |
| | | 1915 | 98,967,016 | 6,106,197 | 58,181,041 | 1,625,145 | 34,789,454 | 6,412,335 | 8,147,156 | 4,122,412 | 94,844,604 | 4.17 |
| | | 1916 | 199,905,496 | 14,227,719 | 101,004,332 | 2,993,200 | 86,599,788 | 8,260,965 | 13,180,508 | 16,289,998 | 183,615,498 | 8.15 |
| | | 1917 | 182,555,213 | 25,805,695 | 64,112,966 | 2,769,071 | 94,715,543 | 10,449,195 | 15,297,257 | 49,420,869 | 133,134,344 | 27.07 |
| | | 1918 | 132,235,883 | 22,643,331 | 60,910,277 | 2,670,314 | 53,588,578 | 13,334,649 | 19,911,266 | 67,320,726 | 64,915,157 | 50.91 |
| | | 1919 | 142,628,952 | 21,790,282 | 77,251,286 | 2,878,190 | 49,049,031 | 14,011,149 | 22,350,986 | 74,361,465 | 68,267,487 | 52.14 |
| $100,000 to 300,000 | 388 | 1914 | 69,641,194 | 6,141,013 | 22,166,068 | 4,076,406 | 40,905,233 | 11,196,451 | 14,843,977 | 2,128,816 | 67,512,378 | 3.05 |
| | | 1915 | 121,097,492 | 9,263,506 | 54,793,137 | 4,182,218 | 55,530,621 | 12,376,037 | 15,048,027 | 5,287,631 | 115,809,861 | 4.37 |
| | | 1916 | 192,529,141 | 14,433,731 | 79,999,848 | 4,556,128 | 95,075,687 | 15,786,445 | 17,322,698 | 15,862,673 | 176,666,468 | 8.24 |
| | | 1917 | 165,690,343 | 17,657,132 | 51,682,500 | 2,660,360 | 100,546,379 | 16,310,431 | 23,166,459 | 49,391,150 | 116,299,193 | 29.81 |
| | | 1918 | 133,293,613 | 17,928,700 | 43,005,259 | 2,088,603 | 82,266,370 | 16,872,557 | 28,867,376 | 71,964,654 | 61,328,959 | 33.98 |
| | | 1919 | 112,655,907 | 16,515,601 | 32,529,909 | 2,661,173 | 69,076,566 | 16,845,477 | 24,972,819 | 59,890,630 | 52,765,277 | 53.16 |
| $300,000 to 1,000,000 | 234 | 1914 | 114,735,947 | 3,135,005 | 19,863,150 | 12,061,095 | 80,944,608 | 19,535,845 | 20,803,756 | 5,018,472 | 109,717,475 | 4.37 |
| | | 1915 | 179,925,979 | 3,321,843 | 65,601,858 | 12,181,893 | 99,231,079 | 21,060,008 | 21,670,702 | 9,366,473 | 170,559,506 | 5.21 |
| | | 1916 | 208,856,283 | 3,462,328 | 62,551,254 | 12,873,531 | 129,765,923 | 25,345,435 | 25,142,188 | 19,816,323 | 189,039,960 | 9.49 |
| | | 1917 | 157,205,548 | 4,399,440 | 24,042,173 | 5,174,814 | 125,642,808 | 25,889,077 | 27,942,764 | 49,669,927 | 107,535,621 | 31.60 |
| | | 1918 | 114,221,402 | 4,510,981 | 10,774,115 | 4,456,726 | 99,169,208 | 25,330,214 | 30,019,842 | 64,250,903 | 49,970,499 | 56.25 |
| | | 1919 | 105,643,524 | 4,190,928 | 7,986,257 | 4,071,359 | 98,419,799 | 24,335,579 | 33,360,398 | 59,790,899 | 45,852,625 | 56.60 |
| $1,000,000 and over. | 57 | 1914 | 126,943,491 | 1,250,710 | 11,268,074 | 6,878,209 | 93,688,967 | 29,760,249 | 15,902,718 | 7,346,825 | 119,596,666 | 5.79 |
| | | 1915 | 135,454,068 | 1,460,137 | 15,820,488 | 6,945,017 | 99,148,500 | 29,832,767 | 17,752,841 | 7,971,243 | 127,482,825 | 5.89 |
| | | 1916 | 164,127,187 | 1,149,055 | 23,850,172 | 7,969,100 | 120,694,429 | 30,157,627 | 19,693,196 | 18,398,813 | 145,728,374 | 11.21 |
| | | 1917 | 149,866,591 | 1,270,498 | 4,469,631 | 4,637,862 | 143,244,429 | 30,881,238 | 34,637,067 | 59,771,128 | 90,095,463 | 39.88 |
| | | 1918 | 96,634,583 | 1,671,542 | *9,333,292 | 5,410,280 | 101,723,870 | 24,740,078 | 27,577,895 | 61,633,454 | 35,001,129 | 63.78 |
| | | 1919 | 99,429,113 | 1,478,567 | 1,213,375 | 5,866,255 | 97,203,162 | 22,468,661 | 28,800,907 | 61,975,472 | 37,453,641 | 62.33 |
| Assembled. | 1,240 | 1914 | 333,871,933 | 15,334,846 | 64,850,747 | 24,192,723 | 226,620,438 | 64,823,521 | 61,950,342 | 14,833,897 | 319,038,036 | 4.44 |
| | | 1915 | 535,444,555 | 20,151,683 | 194,596,524 | 24,934,273 | 288,699,654 | 69,681,147 | 62,618,726 | 26,747,759 | 508,696,796 | 5.00 |
| | | 1916 | 765,418,107 | 33,272,833 | 267,405,606 | 28,391,959 | 432,135,827 | 79,550,472 | 75,338,590 | 70,367,807 | 695,050,300 | 9.20 |
| | | 1917 | 655,317,695 | 49,132,765 | 144,307,270 | 15,242,107 | 464,149,159 | 83,529,941 | 101,043,547 | 208,253,074 | 447,064,621 | 31.78 |
| | | 1918 | 476,385,481 | 46,754,554 | 105,356,359 | 14,625,923 | 336,748,026 | 79,277,498 | 106,376,879 | 265,169,737 | 211,215,744 | 55.66 |
| | | 1919 | 460,357,496 | 43,975,378 | 118,980,827 | 15,476,977 | 313,748,558 | 77,660,866 | 109,485,110 | 256,018,466 | 204,339,030 | 55.61 |

*Loss.

$3,000,000; 2 between $1,500,000 and $2,000,000; and 8 between $1,000,000 and $1,500,000.

Each income class group presents similar cases of extraordinary income expansion. In the group of 57 individuals who reported between $250,000 and $300,000 in 1914, 1 reported between $2,000,000 and $3,000,000 in 1915; and 1, over $9,000,000 in 1916.

Of the 98 persons with net incomes in 1914 between $300,000 and $400,000, 3 reported in aggregate over $39,000,000 in 1915; 3 between $1,500,000 and $2,000,000; 2 between $1,000,000 and $1,500,000; and 14 between $500,000 and $1,000,000. In 1916, of this same group 5 reported in aggregate over $24,000,000; 2 between $2,000,000 and $3,000,000; 6 between $1,500,000 and $2,000,000; 2 between $1,000,000 and $1,500,000; and 24 between $500,000 and $1,000,000.

The foregoing are perhaps the most unusual cases of sudden acquisition of large incomes. In each of the income classes there is a general rearrangement or curve extending through the higher classes, reaching the apex in 1916 and falling backward through 1917, 1918, and 1919. This is illustrated in Table B, which shows the aggregate net income reported for the series of years by groups of individuals, segregated by income classes on the basis of the net income reported for the calendar year 1914.

The correlation of the rise and fall of incomes in the different classes with the variation in the amounts reported according to sources of income is exhibited in Table 2, which shows the aggregate net income as well as the amounts reported by sources of income; also the miscellaneous deductions and income tax assessed by groups of returns for each of the years.

In Table 3, under like headings, is shown by percentages the ratio for each year to the amounts reported for 1914.

As viewed either by aggregates or relatively as to 1914, the income of the group of persons who in 1914 reported less than $100,000 shows the most remarkable expansion. As expressed by percentages the growth of net income of this class during the years covered herein shows the ratio to the amount reported in 1914 as 439 per cent in 1915; 886 per cent in 1916; 811 per cent in 1917; 586 per cent in 1918; and 632 per cent in 1919. None of the other income class groups shows even a close approximation to these figures.

The largest growth in any of the other income classes was in the group reporting between $100,000 and $300,000 in 1914, whose ratio in 1916 to 1914 was 276 per cent, whereas the lowest percentages of increase in net income for the various years over 1914 were recorded by the group of persons whose net incomes in 1914 were $1,000,000 and over. In 1915

TABLE 3.

NET INCOME AND INCOME BY SOURCES, SHOWING BY PERCENTAGES THE RATIO FOR EACH YEAR TO THE AMOUNT REPORTED FOR 1914, BY THE SAME INDIVIDUALS GROUPED ACCORDING TO SIZE OF NET INCOME FOR 1914.
RETURNS OF 1,240 PERSONS, EACH OF WHOM REPORTED NET INCOME OF $300,000 AND OVER IN ONE OR MORE YEARS 1914–1919.

| Nature of Income. | Income Class. | 1914 | 1915 | 1916 | 1917 | 1918 | 1919 |
|---|---|---|---|---|---|---|---|
| Net Income. | Under $100,000 | 100 | 439 | 886 | 811 | 586 | 632 |
| | $100,000 to 300,000 | 100 | 174 | 276 | 238 | 191 | 162 |
| | 300,000 to 1,000,000 | 100 | 157 | 182 | 137 | 100 | 92 |
| | 1,000,000 and over. | 100 | 107 | 129 | 118 | 76 | 78 |
| | Aggregate.... | 100 | 160 | 229 | 196 | 143 | 138 |
| Salaries, commissions, fees, etc. | Under $100,000 | 100 | 127 | 296 | 537 | 471 | 453 |
| | $100,000 to 300,000 | 100 | 151 | 235 | 287 | 292 | 269 |
| | 300,000 to 1,000,000 | 100 | 106 | 110 | 140 | 144 | 133 |
| | 1,000,000 and over. | 100 | 117 | 92 | 102 | 134 | 118 |
| | Aggregate.... | 100 | 131 | 217 | 320 | 304 | 287 |
| Business and profits from sales of real estate, stocks, bonds, etc. | Under $100,000 | 100 | 504 | 874 | 555 | 527 | 669 |
| | $100,000 to 300,000 | 100 | 247 | 361 | 233 | 194 | 147 |
| | 300,000 to 1,000,000 | 100 | 331 | 315 | 121 | 54 | 40 |
| | 1,000,000 and over. | 100 | 140 | 212 | 40 | -83 | 11 |
| | Aggregate.... | 100 | 300 | 412 | 223 | 162 | 183 |
| Rents and royalties. | Under $100,000 | 100 | 138 | 254 | 235 | 227 | 245 |
| | $100,000 to 300,000 | 100 | 103 | 112 | 65 | 51 | 65 |
| | 300,000 to 1,000,000 | 100 | 101 | 107 | 43 | 37 | 34 |
| | 1,000,000 and over. | 100 | 101 | 116 | 67 | 79 | 86 |
| | Aggregate.... | 100 | 103 | 117 | 63 | 60 | 64 |
| Dividends. | Under $100,000 | 100 | 314 | 781 | 855 | 485 | 443 |
| | $100,000 to 300,000 | 100 | 136 | 232 | 246 | 201 | 169 |
| | 300,000 to 1,000,000 | 100 | 123 | 160 | 155 | 123 | 122 |
| | 1,000,000 and over. | 100 | 106 | 129 | 153 | 109 | 104 |
| | Aggregate.... | 100 | 127 | 191 | 204 | 149 | 138 |
| Interest. | Under $100,000 | 100 | 148 | 191 | 241 | 285 | 323 |
| | $100,000 to 300,000 | 100 | 111 | 141 | 146 | 151 | 150 |
| | 300,000 to 1,000,000 | 100 | 108 | 130 | 133 | 130 | 125 |
| | 1,000,000 and over. | 100 | 100 | 101 | 104 | 83 | 75 |
| | Aggregate.. | 100 | [illegible] | 123 | 129 | 122 | 120 |

NET INCOME AND INCOME BY SOURCES, SHOWING BY PERCENTAGES THE PROPORTION OF THE AGGREGATE, REPORTED EACH YEAR, BY THE SAME INDIVIDUALS GROUPED ACCORDING TO SIZE OF NET INCOME FOR 1914.

RETURNS OF 1,240 PERSONS, EACH OF WHOM REPORTED NET INCOME OF $300,000 AND OVER IN ONE OR MORE YEARS 1914–1919.

| Nature of Income. | Income Class. | 1914 | 1915 | 1916 | 1917 | 1918 | 1919 |
|---|---|---|---|---|---|---|---|
| Net Income. | Under $100,000 | 6.75 | 18.49 | 26.12 | 27.86 | 27.76 | 30.98 |
| | $100,000 to 300,000 | 20.86 | 22.61 | 25.15 | 25.28 | 27.99 | 24.47 |
| | 300,000 to 1,000,000 | 34.36 | 33.60 | 27.29 | 23.99 | 23.98 | 22.95 |
| | 1,000,000 and over. | 38.03 | 25.30 | 21.44 | 22.87 | 20.27 | 21.60 |
| | Aggregate.... | 100. | 100. | 100. | 100. | 100. | 100. |
| Salaries, commissions, fees, etc. | Under $100,000 | 31.35 | 30.31 | 42.76 | 52.52 | 48.43 | 49.55 |
| | $100,000 to 300,000 | 40.05 | 45.96 | 43.37 | 35.93 | 38.35 | 37.56 |
| | 300,000 to 1,000,000 | 20.44 | 16.48 | 10.41 | 8.96 | 9.65 | 9.53 |
| | 1,000,000 and over. | 8.16 | 7.25 | 3.46 | 2.59 | 3.57 | 3.36 |
| | Aggregate.... | 100. | 100. | 100. | 100. | 100. | 100. |
| Business and profits from sales of real estate, stocks, bonds, etc. | Under $100,000 | 17.81 | 29.89 | 37.77 | 44.42 | 57.82 | 64.93 |
| | $100,000 to 300,000 | 34.18 | 28.16 | 29.91 | 35.82 | 40.82 | 27.34 |
| | 300,000 to 1,000,000 | 30.63 | 33.82 | 23.39 | 16.66 | 10.23 | 6.71 |
| | 1,000,000 and over. | 17.38 | 8.13 | 8.93 | 3.10 | *- 8.87 | 1.02 |
| | Aggregate.... | 100. | 100. | 100. | 100. | 100. | 100. |
| Rents and royalties. | Under $100,000 | 4.86 | 6.50 | 10.54 | 18.17 | 18.24 | 18.60 |
| | $100,000 to 300,000 | 16.88 | 16.80 | 16.05 | 17.45 | 14.34 | 17.19 |
| | 300,000 to 1,000,000 | 49.84 | 48.85 | 45.34 | 33.95 | 30.46 | 26.30 |
| | 1,000,000 and over. | 28.42 | 27.85 | 28.07 | 30.43 | 36.96 | 37.91 |
| | Aggregate.... | 100. | 100. | 100. | 100. | 100. | 100. |
| Dividends. | Under $100,000 | 4.89 | 12.05 | 20.04 | 20.41 | 15.92 | 15.63 |
| | $100,000 to 300,000 | 18.06 | 19.23 | 22.00 | 21.67 | 24.43 | 22.02 |
| | 300,000 to 1,000,000 | 35.71 | 34.37 | 30.03 | 27.07 | 29.45 | 31.37 |
| | 1,000,000 and over. | 41.34 | 34.35 | 27.93 | 30.85 | 30.20 | 30.98 |
| | Aggregate.... | 100. | 100. | 100. | 100. | 100. | 100. |
| Interest. | Under $100,000 | 6.68 | 9.20 | 10.38 | 12.50 | 15.55 | 18.04 |
| | $100,000 to 300,000 | 17.28 | 17.76 | 19.84 | 19.52 | 21.29 | 21.70 |
| | 300,000 to 1,000,000 | 30.13 | 30.22 | 31.86 | 31.00 | 31.95 | 31.33 |
| | 1,000,000 and over. | 45.91 | 42.82 | 37.92 | 36.98 | 31.21 | 28.93 |
| | Aggregate.... | 100. | 100. | 100. | 100. | 100. | 100. |

*Loss.

the ratio to 1914 was 107 per cent; in 1916, 129 per cent; in 1917, 118 per cent; in 1918, 76 per cent; and in 1919, 78 per cent.

Both in actual amount and in relative growth the persons in the lowest income group in 1914 likewise outranked any of the other income classes in the amounts reported in the succeeding years as having been derived from salaries and business ventures. This same group also shows a relatively larger yearly growth in income from investments as compared with 1914 than any of the others.

The remarkable rise in fortune of this group of individuals, as compared with the narrower fluctuation of incomes of the persons in the higher income classes, is indicative of the spirit of adventure, the seizing of opportunities, and the taking of chances by the average person, as against the conservative tendency of persons with larger incomes. As evidence of this the group in question reported incomes from business ventures and profits from sales of real estate, stocks, etc., in the following ratio as compared with 1914, 504 per cent in 1915; 874 per cent in 1916; 555 per cent in 1917; 527 per cent in 1918; and 669 per cent in 1919. The other income classes showed a markedly less relative increase of income from this source.

Table 4 shows by percentages the changes from year to year in the proportion of the aggregate net income and income by sources, as reported by the same individuals grouped according to size of net income for 1914. In this table the variation in the proportion reported by each group to the aggregate for each year again indicates the great expansion in income of the group of individuals who composed the "under $100,000" class in 1914. In that year the proportion reported by this group of persons was 6.75 per cent of the aggregate net income, increasing from year to year until in 1919 their income represented 31 per cent of the total reported by the four groups.

When the above increase for 1919 over 1914 is considered in connection with the increase in the aggregate net income of 38 per cent for the same years, the quantitative expansion becomes still more significant.

The persons in the next higher income group maintained a more consistent proportion during the several years, although in this case also the ratio to the aggregate for 1919 was somewhat larger than in 1914. The two highest income groups materially decreased in the proportion of the total income reported, the persons having between $300,000 and $1,000,000 in 1914 reporting 34.36 per cent of the total income for that year, whereas in 1919 the proportion had fallen to 22.95 per cent.

The group whose incomes in 1914 were $1,000,000 and over reported in that year 38.03 per cent of the total, whereas in 1919 the proportion had fallen to 21.60 per cent.

### TABLE 5.

### DISTRIBUTION BY INCOME CLASSES FOR EACH OF THE YEARS 1914-1919. RETURNS AND NET INCOME OF 1,240 PERSONS EACH OF WHOM REPORTED IN EXCESS OF $300,000 IN ONE OR MORE OF THE ABOVE YEARS.

| Income Class. | 1914 | | 1915 | | 1916 | | 1917 | | 1918 | | 1919 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Number. | Net income. | Number. | Net income. | Number. | Net income. | Number. | Net income. | Number | Net income. | Number | Net income. |
| Reporting deficit..... | 23 | $ 1,571,606 | 10 | $ 812,138 | 3 | $ 153,983 | 3 | $ 19,161 | 12 | $ 2,365,537 | 35 | $ 5,564,812 |
| $ Under $ 10,000 | 59 | 380,562 | 24 | 174,446 | 8 | 58,657 | 8 | 53,671 | 9 | 50,960 | 14 | 85,582 |
| 10,000 to 25,000 | 104 | 1,765,378 | 53 | 896,759 | 19 | 353,826 | 10 | 170,315 | 28 | 505,373 | 33 | 545,771 |
| 25,000 " 50,000 | 156 | 5,913,947 | 96 | 3,527,744 | 31 | 1,109,383 | 23 | 833,151 | 54 | 2,102,887 | 59 | 2,192,909 |
| 50,000 " 100,000 | 219 | 16,063,020 | 170 | 12,632,651 | 73 | 5,550,709 | 61 | 4,598,442 | 120 | 9,106,213 | 123 | 8,977,929 |
| 100,000 " 150,000 | 150 | 18,495,835 | 111 | 13,921,702 | 83 | 10,461,057 | 68 | 8,486,026 | 115 | 14,363,956 | 143 | 18,152,528 |
| 150,000 " 200,000 | 102 | 17,792,202 | 136 | 23,746,300 | 96 | 16,839,499 | 77 | 13,317,934 | 123 | 21,408,409 | 111 | 19,457,871 |
| 200,000 " 250,000 | 79 | 17,971,504 | 92 | 20,651,313 | 96 | 21,404,470 | 77 | 17,318,356 | 89 | 20,182,052 | 99 | 22,198,375 |
| 250,000 " 300,000 | 57 | 15,381,653 | 87 | 24,138,796 | 121 | 33,374,292 | 105 | 29,192,892 | 95 | 26,097,267 | 84 | 23,057,776 |
| 300,000 " 400,000 | 98 | 33,895,936 | 127 | 43,662,066 | 165 | 57,455,270 | 295 | 101,776,731 | 243 | 84,580,278 | 214 | 72,681,222 |
| 400,000 " 500,000 | 46 | 20,526,125 | 72 | 32,381,540 | 112 | 50,228,359 | 161 | 71,483,543 | 121 | 53,942,119 | 111 | 49,512,663 |
| 500,000 " 750,000 | 69 | 42,050,577 | 116 | 70,107,128 | 185 | 110,814,994 | 172 | 104,892,405 | 123 | 75,076,595 | 105 | 62,224,912 |
| 750,000 " 1,000,000 | 21 | 18,263,309 | 43 | 37,408,821 | 90 | 76,304,258 | 72 | 61,530,438 | 44 | 37,207,569 | 53 | 45,181,507 |
| 1,000,000 " 1,500,000 | 26 | 31,270,554 | 40 | 48,899,750 | 66 | 78,935,921 | 49 | 59,389,705 | 30 | 35,883,536 | 26 | 32,104,537 |
| 1,500,000 " 2,000,000 | 16 | 27,446,872 | 34 | 59,278,971 | 33 | 56,632,627 | 25 | 41,807,348 | 16 | 26,878,507 | 12 | 20,407,687 |
| 2,000,000 " 3,000,000 | 8 | 18,899,957 | 17 | 42,580,252 | 27 | 64,927,657 | 19 | 46,046,173 | 11 | 26,777,977 | 7 | 17,845,218 |
| 3,000,000 and over... | 7 | 49,326,108 | 12 | 102,248,454 | 32 | 181,121,111 | 15 | 94,439,726 | 7 | 44,587,320 | 11 | 71,295,821 |
| Total......... | 1,240 | 333,871,933 | 1,240 | 535,444,555 | 1,240 | 765,418,107 | 1,240 | 655,317,695 | 1,240 | 476,385,481 | 1,240. | 460,357,496 |

Table 5 shows the 1,240 returns segregated by income classes for each of the years 1914–1919, and the redistribution of the number reporting from year to year in the various income class steps. It does not, however, show the diffusion of the returns of any one income class in any one year throughout the income class scale in other years. This is shown in Tables C to F.

### TABLE C

### DISPERSION OF THE GROUP OF PERSONS WHOSE INCOMES IN 1914 WERE NOT IN EXCESS OF $100,000 THROUGHOUT THE RANGE OF INCOME CLASSES IN THE SEVERAL YEARS

| Income class | 1914 | 1915 | 1916 | 1917 | 1918 | 1919 |
|---|---|---|---|---|---|---|
| Under $100,000 | 561 | 322 | 122 | 87 | 150 | 159 |
| $100,000–300,000 | ... | 161 | 240 | 201 | 225 | 189 |
| 300,000–1,000,000 | ... | 63 | 172 | 255 | 183 | 205 |
| 1,000,000 and over | ... | 15 | 27 | 18 | 3 | 8 |
| | 561 | 561 | 561 | 561 | 561 | 561 |

### TABLE D

### DISTRIBUTION BY INCOME CLASSES AND BY YEARS OF THE GROUP WHOSE NET INCOMES FOR 1914 WERE BETWEEN $100,000 AND $300,000

| Income class | 1914 | 1915 | 1916 | 1917 | 1918 | 1919 |
|---|---|---|---|---|---|---|
| Under $100,000 | ... | 31 | 11 | 16 | 46 | 63 |
| $100,000–300,000 | 388 | 243 | 139 | 98 | 140 | 175 |
| 300,000–1,000,000 | ... | 104 | 209 | 261 | 191 | 143 |
| 1,000,000 and over | ... | 10 | 29 | 13 | 11 | 7 |
| | 388 | 388 | 388 | 388 | 388 | 388 |

### TABLE E

### DISTRIBUTION BY INCOME CLASSES AND BY YEARS OF THE GROUP WHOSE NET INCOMES FOR 1914 WERE BETWEEN $300,000 AND $1,000,000

| Income class | 1914 | 1915 | 1916 | 1917 | 1918 | 1919 |
|---|---|---|---|---|---|---|
| Under $100,000 | ... | ... | ... | ... | 20 | 34 |
| $100,000–300,000 | ... | .22 | 15 | 27 | 52 | 67 |
| 300,000–1,000,000 | 234 | 187 | 168 | 174 | 144 | 115 |
| 1,000,000 and over | ... | 25 | 51 | 33 | 18 | 18 |
| | 234 | 234 | 234 | 234 | 234 | 234 |

### TABLE F

### DISTRIBUTION BY INCOME CLASSES AND BY YEARS OF THE GROUP WHOSE NET INCOMES FOR 1914 WERE $1,000,000 AND OVER

| Income class | 1914 | 1915 | 1916 | 1917 | 1918 | 1919 |
|---|---|---|---|---|---|---|
| Under $1,000,000 | ... | ... | 1 | 2 | 7 | 8 |
| $100,000–300,000 | ... | ... | 2 | 1 | 5 | 6 |
| 300,000–1,000,000 | ... | 4 | 3 | 10 | 13 | 20 |
| 1,000,000 and over | 57 | 53 | 51 | 44 | 32 | 23 |
| | 57 | 57 | 57 | 57 | 57 | 57 |

The discussion in the preceding text deals with the incomes before deducting the federal income taxes paid to the government. The enormous increase both in the amount of such taxes and in the percentage of tax to net income during the period 1914-1919 can be visualized from the following table, which shows in comparative form the amounts paid for the first and the last years of the series.

The taxes paid by the 561 individuals whose net incomes in 1914 were under $100,000 were in that year approximately $340,000, or 1.51 per cent of their total net incomes. In 1919 these same individuals paid the government $74,361,465, or 52.14 per cent of their net incomes for that year. A more or less similar increase in the amount of taxes is shown for each of the other groups in Table G.

TABLE G
COMPARATIVE TABLE OF INCOME TAX PAID FOR 1914 AND 1919

| Income class | Year | Number of returns | Income tax | Per cent of tax to net income |
|---|---|---|---|---|
| Under $100,000 | 1914 | 561 | $339,784 | 1.51 |
| | 1919 | | 74,361,465 | 52.14 |
| $100,000 to 300,000 | 1914 | 388 | $2,128,816 | 3.05 |
| | 1919 | | 59,890,630 | 53.16 |
| $300,000 to 1,000,000 | 1914 | 234 | $5,018,472 | 4.37 |
| | 1919 | | 59,790,899 | 56.60 |
| $1,000,000 and over | 1914 | 57 | $7,346,825 | 5.79 |
| | 1919 | | 61,975,472 | 62.33 |
| Assembled | 1914 | 1,240 | $14,833,897 | 4.44 |
| | 1919 | | 256,018,466 | 55.61 |

The amount of tax that was taken by the government for each of the years 1914–1919 and its proportion of the net income of these individuals are shown in detail in Table 2.

A realignment of these 1,240 individuals by income classes on the basis of the net income reported by each for 1919 and showing under this distribution the net incomes reported by the same persons in each year is shown in Table H (p. 71).

As compared with the distribution shown in Table 1, previously referred to, the number of individuals reporting under $100,000 decreased from 561 in 1914 to 264 in 1919; in contrast to which the returns of individuals reporting between $100,000 and $300,000, and between $300,000 and a million dollars, increased respectively from 388 to 437 in the first class and 234 to 483 in the second. Those reporting a million and over were 57 in 1914 and 56 in 1919.

The comparison of the two tables also shows the fluctuation of the net income from year to year on the basis of the realignment by income classes for 1919, and illustrates in striking contrast the increase in the net incomes reported for the last year over the first year of the series by persons in the lower classes in 1914, as against the decrease during the same years in the net incomes of persons reporting in the lower classes in 1919; and, contrariwise, the decrease in the net income reported for the two marginal years by the persons in the higher income classes in 1914 as against the increase in the net income reported for these years by the persons in the higher income classes in 1919.

The net income of the 561 people who in 1914 reported under $100,000 increased from $22,551,000 in 1914 to $142,629,000 in 1919; the net income reported by 264 people reporting in this same class in 1919 decreased from $47,000,000 in 1914 to $6,237,000 in 1919.

Of the group reporting between $100,000 and $300,000, the incomes of the 388 persons reporting in 1914 increased from $69,641,000 in 1914 to $112,656,000 in 1919, whereas the incomes of the 437 persons who in 1919 reported in this class amounted to $80,165,000 in 1914 and $82,867,000 in 1919.

In the class reporting between $300,000 and $1,000,000, the incomes of the 234 persons reporting in 1914 fell from $114,736,000 in 1914 to $105,644,000 in 1919, whereas the 483 persons reporting in this class in 1919 showed an increase in income from $127,458,000 in 1914 to $229,600,000 in 1919.

As in the preceding class, the incomes of those reporting a million dollars and over showed a decrease for the 57 persons who reported incomes in this class in 1914 from $126,943,000 in that year to $99,429,000 in 1919, and an increase in the incomes of the 56 persons who reported in this class in 1919 from $79,162,000 in 1914 to $141,653,000 in 1919.

In the study of the fluctuation of incomes it should be observed that the comparability of the net incomes reported for the various years in the returns for federal income tax purposes is affected by the changes in the provisions of the several income tax laws under which the returns were filed.

The Revenue Act of 1913 prohibited the deduction of losses sustained in transactions entered into for profit other than in connection with the taxpayers' regular business. This provision, however, was to some extent amended in the Revenue Act of 1916, under which losses incurred from such transactions, although not in connection with the regular business of the taxpayer, were allowed to the extent of but not to exceed the gains arising from such transactions. The same provision was contained in the Revenue Act of 1917.

The Revenue Act of 1918, however, removed the limitation and provided that losses arising from transactions entered into for profit were to be allowed whether such transactions were in connection with the regular business or not. Had the provisions of the Revenue Act of 1918 respecting the deduction of losses been in force throughout the entire period, the amounts reported as net income for the years 1914–17 inclusive would in many cases have been considerably less. Moreover, in 1917, 1918, and 1919 contributions (not in excess of 15 per cent of the net income) made to corporations organized and operated for religious, charitable, scientific, or educational purposes were deductible.

Had this provision obtained in the previous years the amount of net income reported in such years would likewise have been less than that shown in the attached tables, and to the extent of such undeductible losses and contributions in the previous years the comparability of the incomes shown in the tables, and especially of the incomes of the persons in the higher classes, is affected.

# NOTES

## THIRD REPORT OF THE ADVISORY COMMITTEE OF THE CENSUS

The Joint Advisory Committee to the Director of the Census representing your two associations respectfully submits herewith the third Report of Progress

*To the American Economic Association and the American Statistical Association:*

We venture to remind you at the outset that this Committee was appointed at the Richmond meetings of the associations in 1918 at the request of the Secretary of Commerce. The president of each association was invited to designate members to form a joint committee to advise the Director of the Census concerning the many problems connected with the taking of the Fourteenth Census and the tabulation and publication of the results. The Fourteenth Census period as defined and provided by law covers three years, extending from June, 1919 to July, 1922. Your Committee, therefore, considers that its commission from you extends to the conclusion of the period specified, which will be practically coincident with the completion of the final reports of the Fourteenth Census, and expects to render a final report at the annual meetings of these two associations in 1922.

The year 1921 has been important in the affairs of the Census Bureau, since it includes the change of federal administration and also that of the Directorship of the Census. The new Secretary of Commerce, Mr. Hoover, promptly expressed his approval of your Advisory Committee, and increased its responsibilities. He had been fully informed of the Committee's work, and at once requested our assistance in connection with some of the problems which confronted him in the Department. In March, the Director of the Census under whom the work of this Committee began, resigned his office and the Assistant Director, Mr. William M. Steuart, was appointed to fill the vacancy. Fortunately, Mr. Steuart was a man skilled in census work after many years of service in the Bureau. As Assistant Director, he carried the burden of the advance organization and actual taking of the Fourteenth Census. The newly appointed Director of the Census was thus already familiar with such advantages as exist in committee coöperation, and at once expressed his wish for even closer relationship. It is a pleasure to report, therefore, that the cordial attitude of the Secretary of

Commerce and that of the Director and his associates have not only promoted the usefulness of your Committee but have made the task of counselling the Bureau increasingly agreeable and worth while.

Your Committee realizes that their assignment by the Secretary of Commerce to problems concerning the Department, which were remotely related or entirely unrelated to the census, is not strictly subject to report to the two associations. Such assignments the Committee naturally regarded as merely personal service. It is a fact, however, that the Secretary utilized for his own needs a going machine, and that that machine was yours. This, perhaps, justifies mentioning here that the Secretary of Commerce in September last entrusted to the Committee the task of preparing the plan of organization and agenda for the President's Conference on Unemployment. To prepare the way for and advise that important gathering, your Committee served as the basic organization. Aided by others, selected by the Committee or the Secretary, studies concerning the number of unemployed, the causes of unemployment and possible means of relief, were rapidly prepared and submitted to the Conference for consideration and action.

Whatever service resulted from this task may thus indirectly be traced to your creation of a joint committee to coöperate with the Director of the Census. This development, indeed, affords further and very interesting evidence of the way in which disinterested private organizations can be of service to the federal government under proper arrangements for coöperation.

Since our last report, nine meetings of the Committee, or of designated members of the Committee, have occurred in Washington, as follows: January 27–30, March 10–14, April 6–10, May 4–7, May 26–29, June 13–18, July 20–22, September 7–9, and November 17–19. Subcommittees have also met at other points: of these, three meetings were held in New York and three in Boston. Each member of the Committee thus has given liberally of his time, often at great personal inconvenience. The meetings of the full committee in most instances have been attended by the entire membership.

The meeting of March 10–14 was devoted almost exclusively to a discussion of the proposed methods of Congressional apportionment. At the request of the Chairman of the Committee on the Census of the United States Senate, the Director of the Census requested the Joint Advisory Committee to hold a session as promptly as convenient for the purpose of considering the various methods of apportionment proposed, with a view to making a report to the Senate Committee upon the merits of the methods submitted. Advocates of the various methods proposed were heard in person and also submitted memoranda to the Committee, which resulted in a brief report to the Director of the Census embodying the Committee's conclusions. For this meeting, the Director of the Census, at the request of the Committee, invited Professor Allyn A. Young, of Harvard, to sit with the Advisory Committee. Professor Young's assistance proved of such value that at the request of both the Committee and the officials of the Bureau, he consented to become a permanent member. Being a member of both of the associations represented, and a former president of each, your Committee has ventured to assume that their action would command the hearty approval of both organizations.

During the past year the Director of the Census has made increasing use of the Committee, submitting to it various problems arising in connection with census policy and with the preparation and publication of census results. The tendency of the Bureau noted in our last Report of Progress to utilize the Committee as an advisory court of appeal for decisions upon matters of census policy or statistical form has increased during the past year, and subjects about which there is doubt or difference of opinion within the Bureau are, for the most part, laid aside until they can be submitted to the Committee for its recommendations. In this way, policies which the two associations would desire to see established in the Bureau are being adopted.

It should be added also that as the members of the Joint Advisory Committee have come in closer touch with the officials of the Bureau they have been able, by comment and counsel, to be of assistance in many ways which do not appear in formal recommendations.

During the year twenty-six formal recommendations have been made dealing with practically all the branches of current census activity. The text of the recommendations is appended to this report.

Your Committee has continued earnestly to advocate the preparation of special studies, and has considered this as perhaps the most important of the recommendations here included. This policy was first outlined in one of the early recommendations, adopted two years ago, and has been consistently urged at intervals since that time. With the approaching completion of the main reports of the census, and the release of clerks and experts available for work upon such studies, the Director has approved the policy advocated by the Committee, and it is believed that the special studies outlined by the Committee in consultation with census officials, if successfully prepared, will prove a most important and gratifying departure in connection with census work.

Pursuant to this policy, the Advisory Committee has recommended to the Census Bureau eighteen topics, the elaboration of which by supplementary tables and effective interpretation will be obviously timely and important. These topics will be found in Recommendation #76 appended hereto.

The Committee has named to the Director of the Census a number of men who in its judgment would be fully able to interpret census figures on the various topics upon which monographs were suggested. In certain cases, also, it has tried to induce men to undertake the preparation of monographs. In view of the inadequate sums which the Bureau can pay for such service it has naturally in many cases been impossible to secure the services of men recommended. This has been a great disappointment to the Committee and the Bureau. There is no branch of the Bureau's work which comes so closely home to the economists and statisticians of the country, and thus to the Committee aiming to represent them, as the work of interpretation. There is none in which the room for improvement is greater. If the Committee fails here it will fail in its most important task, and the Fourteenth Census will mean much less than it might mean, both to students and to the public.

In the Committee's judgment the members of these associations who have been or will be asked to assist in the preparation of monographs might well consider that the recognition by the invitation to prepare a section to be published by the Bureau over the name of the writer and included in a series like the census volumes, sure to be frequently consulted by scholars through coming decades and century, is no small part of the writer's compensation. The Census Bureau, in addition to a modest compensation, is ready to prepare tables proposed by the contributor and approved by it, to pay the cost of the necessary trips to Washington by the author for consultation with the Bureau authorities, and to make the resources of its clerical force available for the preparation of derivative tables. These are elements the importance of which should be carefully weighed.

Investigators are also reminded that any one working upon census figures in his study and without contact with the men responsible for their production is in danger of misinterpreting the figures and thus going far astray. This has happened frequently in the past and has tended to develop misunderstandings between the producers of statistics and the students who use them. On the other hand, writers conferring with the Census Bureau have a far better chance of producing trustworthy results and of developing a spirit of mutual understanding and coöperation, the value of which will continue long after the special piece of work has been done.

In the series of recommendations made during the past year there are two in addition to that relating to special studies to which your attention is especially invited: (#80) that relating to the determination of policy in constructing the schedule for the biennial census of manufactures, and (#90) that relating to the proposed census of mercantile establishments, sometimes called a commodity census. Both of the recommendations, which have been accepted by the Bureau, embody a definition of census policy, and your Committee is confident that its attitude reflects the prevailing opinion in these two associations.

Pressure was brought to bear by industrial interests to expand the scope of the biennial inquiry. But your Committee, while recognizing the value of the increased data desired, found the reasons for confining the inquiry to products and a few related questions so convincing that they advised the Director to prepare the simpler form of schedule.

A much wider problem of census policy was involved in the Director's request for a recommendation concerning a so-called commodity census.

There is a growing body of opinion, among business men as well as among statisticians, that the information which the census now gives with respect to the extractive industries and manufacturing should be supplemented by statistics of wholesale and retail trade. The problem thus suggested has a variety of important aspects.

For example, there can be no doubt that it would be greatly to our national advantage if we had means of securing adequate knowledge respecting stocks of goods in the hands of producers and middlemen. There were many instances during the war where such knowledge had to be obtained at whatever cost. Similar knowledge, covering a broader field, would render possible a wiser conduct of business operations, and would help to make our whole economic organization more efficient.

It is conceivable that at reasonable intervals there might be a complete census of American business establishments, including manufacturing, along with merchandising and other business activities. In that event, more frequent inquiries might be made into such matters as manufacturing product and mercantile stocks and turnovers.

With respect to these possible developments the Committee thus far has expressed no opinion. It mentions them here in order to suggest the scope and importance of the problem, and it invites suggestions, whether constructive or critical. On the general proposal that there should be, in some form or other, inquiries into commodity stocks, the Committee has expressed itself affirmatively in Recommendation #90, to be found appended to this Report.

A record of the activities of the Bureau of the Census during the past year in connection with the Fourteenth Census is presented herewith as Appendix II. Your Committee believes that this narrative of census work together with the similar statement presented last year will be of much value in connection with future census work.

REPRESENTING THE AMERICAN STATISTICAL AND
THE AMERICAN ECONOMIC ASSOCIATIONS:
WILLIAM S. ROSSITER, *Chairman*
CARROLL W. DOTEN
EDWIN F. GAY
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December 1, 1921

## APPENDIX I

### RESOLUTIONS ADOPTED BY THE JOINT ADVISORY COMMITTEE OF THE AMERICAN STATISTICAL AND THE ECONOMIC ASSOCIATIONS

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65. The Committee, after carefully considering the detailed plans submitted by the Chief Statistician for Population with reference to the form and content of Volume I of the Fourteenth Census Reports, recommends:
    *a.* That it shall contain 5 main tables, viz.: (1) Counties, (2) Minor civil divisions, (3) Incorporated places alphabetically by states, with wards of places of 5,000 or over, (4) Incorporated places of 2,500 or over grouped by size, and (5) Urban and rural population of counties.
    *b.* That the text shall be limited in accordance with the standards previously established for the state bulletins, and that, in lieu of the customary text dealing with the distribution and growth of population, a special study of the increase of population and the retardation of that increase in the last decade, and of the distribution and comparative growth of the rural and urban population, especially between 1910 and 1920, be prepared by the Chief Statistician for Revision and Results and published as a bulletin at or about the same time as Volume I. This study shall constitute a section of a monograph on urban and and rural population which will include in addition such topics as age, race, and nativity.
    *c.* That in addition to the customary comparison between the population living in incorporated places having 2,500 inhabitants or more in 1910 and 1920, a further comparison be made between the population of the same places in 1920, regardless of change of area within the decade. This supplementary comparison, however, should not be undertaken if the Chief Statistician for Population finds that the task will retard seriously the preparation of the main reports.
    *d.* That Table 57 in the chapter on Number and Distribution of Inhabitants be retained in the same form as in 1910, including all cities with a population of 100,000 or over, thereby increasing the number of cities from 50 to 68.

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66. The Advisory Committee, after considering the detailed plans and proofs of the bulletins upon irrigation and drainage submitted by the Chief Statistician for Agriculture, approves:
    *a.* The model for the series of bulletins upon irrigation with the reductions of text and minor changes recommended by this Committee in conference with the Chief Statistician for Agriculture.
    *b.* The model for the series of bulletins upon drainage with the reduction of text and other changes recommended by this Committee in conference with the Chief Statistician for Agriculture or outlined by that official.

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67. The Committee views with concern the loss through resignation of expert special agents engaged in editorial work in the Division of Agriculture and recommends that this group should at once be recruited to 15, its former number and a number still urgently needed if the work of preparing bulletins and reports for publication is not to be seriously delayed.

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68. The Advisory Committee has considered the galley proof of the model state bulletins on manufactures and recommends that the text in this series be greatly re-

duced, especially by omitting whatever is clearly apparent from the tables, so as to conform to the policy already established by the Committee's recommendation in connection with the bulletins on population and agriculture.

69. After consulting with the Chief Statisticians for Population, Manufactures, and Revision and Results and the Geographer of the Census regarding the relations between metropolitan districts and industrial zones, the Advisory Committee recommends that (1) the Division of Manufactures should establish industrial zones wherever its returns show a marked concentration of manufacturing; (2) that the principles in accordance with which these industrial zones are delimited should be clearly defined and published as a matter of record; (3) that in cases where metropolitan districts and industrial zones overlap these two areas should be coterminous, and (4) that the task of defining the principles according to which industrial zones are drawn and the task of making overlapping industrial zones and metropolitan districts coterminous and yet satisfactory for both population and manufacturing statistics should be referred to an office committee.

The Committee calls attention to the fact that on April 24, 1920, it adopted the following resolution (53):

> The Committee approves a plan submitted by the Chief Statistician for Manufactures of reporting data by industrial zones, provided that where so-called metropolitan districts are recognized by the Division of Population, these metropolitan districts and the corresponding industrial zones shall be coterminous.

This important matter is still unsettled. It should be decided within a brief time. Hence in elaborating the fourth recommendation above, the Committee advises the Director of the Census to refer the problem to a committee composed of the Assistant Director, the Chief Statisticians for Population, Manufactures, and Revision and Results, and the Geographer with instructions to formulate rules defining industrial zones and if possible to shape these definitions so that when the two areas overlap they shall be coterminous. In case this office committee fails to agree promptly upon such rules, the Advisory Committee recommends the Director of the Census to settle this problem by executive action.

70. The Advisory Committee is gratified to learn that the Director intends to follow its recommendations as to the use of thin paper for the final reports of the Fourteenth Census, but wishes again to urge strongly that a limited number of copies be printed for Government depositories upon all rag paper, as advised by the Committee in its Recommendation No. 31–5.

In view of the extreme importance of the production of printing matter connected with the Fourteenth Census, the Committee desires to receive at its next meeting, if agreeable to the Director of the Census, a statement from the official in charge of the printing of the Bureau concerning the quality of the service that has been rendered up to that time and a statement in writing based on a conference with the Government Printing Office officials of what can be expected in regard to the bringing out of the remaining publications of the census.

71. The Advisory Committee recommends that to the tentative and partial list of special studies which the Committee in its resolution No. 39 recommended the Director of the Census to have made by qualified experts, the following topic be added, "Central office concerns" in manufactures.

(Rescinded at the meeting of April 9)

72. It is the opinion of the Committee that all Fourteenth Census publications relating to manufactures should be in quarto form.

73. The Committee recommends the following variation from its former recommendation No. 38: The state bulletins on agriculture and manufactures should be so constructed as to permit, by the omission of definition text, their publication in a manner similar to that of the population bulletins, continuous folioing, and inclusion in the main census reports.

(Rescinded at the meeting of April 9)

74. The Advisory Committee regrets that it may be advisable to abandon or curtail the collection of annual statistics of cities and states. These publications have been and still are of great value to economists and students of public finance as affording the only available intercensal facts on state and local finance. They are of importance in bringing about an improved and uniform system of state and local statistics and accounts. The interrelations of federal and local finance are of growing significance to the corporate and other business interests of the country.

It is therefore recommended that before it be finally decided to curtail or discontinue these reports an endeavor be made to ascertain the extent and character of this demand.

75. It is further recommended that the Director of the Census consult Dr. Hill with a view to the preparation of a memorandum on the topics to be chosen for the special census studies and the people being considered.

76. The Committee suggests the following revised and extended list of subjects for the "series of special studies" referred to in its Recommendations 30 and 39.

(1) Growth of Population
(2) Immigrants and Their Children
(3) Native Whites of Native Parentage
(4) Marital Conditions
(5) Illiteracy and School Attendance
(6) Child Labor
(7) Women at Work
(8) Farm Acreage
(9) Farm Values and Their Increase
(10) The Farming Population
(11) Farm Mortgages
(12) Farm Tenure
(13) Development of Mining
(14) Development of Manufactures
(15) Integration and Specialization of Industry
(16) Monthly Fluctuations in Wage-earners in 1899, 1904, 1909, 1914, and 1919
(17) Census Statistics of Annual Earnings
(18) Results of the Special Mortgage Debt Inquiry

77. The Committee recommends that to insure a proper degree of harmony among the special studies, the Director place each study in charge of a committee

consisting of (1) the Assistant Director, (2) the Chief Statistician within whose field the study falls, and (3) the writer. The outlines of the studies and the plans of the tables to be compiled by the office should receive the approval of the committee before being adopted. The plans should contemplate a thorough yet concise treatment of the subject, based so far as possible on compilations already made or planned, and capable of being finished so far as possible by July 1, 1922.

78. The Advisory Committee recommends to the Director of the Census that in addition to the series of special studies or monographs upon selected census topics recommended in Resolutions #30, #39, and #76, a General Report on the entire Fourteenth Census be prepared in the form of a thin octavo volume agreeing in style and format with the Abstract of the Fourteenth Census recommended in Resolution #54. The General Report should consist almost entirely of text with at most only a few very short tables. It should appear very soon after the end of the census period, July 1, 1922.

79. The Advisory Committee recommends to the Director of the Census that he attempt by correspondence with teachers in the leading universities to secure not less than eight young men trained in statistics who might accept appointment for a year as Special Agents in the Bureau of the Census at a salary of about $1,500 a year and who would be given the opportunity to prepare under supervision text for the projected General Report.

80. The Advisory Committee have fully considered the matter of scope and detail of the biennial census of manufactured products ordered by the Fourteenth Census Act, and have taken into consideration the requests of representatives of various industries to secure a reasonably complete census of manufactures. The Committee shares with the industrial interests the belief that such a census would be valuable, but they are compelled to advise strict adherence to the law for several reasons, each of which seems well-nigh sufficient in itself:

(1) The decennial census of manufactures, 1920, is still incomplete, and a considerable force of the trained clerks of the division will be required to complete this work, so that clerical resources are not available for the advance preparation of an industrial census undertaking, and the first biennial census, if extensive, would thus conflict with the concluding operations of the decennial census.

(2) The biennial census as advised by the industrial interests involves such comparatively elaborate inquiry that it could with difficulty be taken and completed within the two-year period, so that it would not only tend to conflict with preparations for the next one, but would present comparatively stale figures. This would defeat the purpose of the law.

(3) The expense of this undertaking would be not less than one and a half million dollars every two years.

(4) Such an enterprise would represent a great increase in census operations at a time when every effort is being made to reduce expenses.

(5) Congress did not contemplate—if the sentences ordering this inquiry be carefully considered—any great enterprise or any heavy additional expenditures. The Act was passed just at the close of the War when by universal consent as much information on products as it was possible to obtain was regarded as

desirable. Undoubtedly the intent of Congress was to secure this information as speedily and inexpensively as possible.

(6) The phraseology of the Act itself is explicit. The Committee believes that serious departure from the instruction of the law is not warranted, and believes also that it would be open to grave criticism.

(7) If, after making the first inquiry as the law directs, it is obviously desirable to expand the inquiry, the authority of Congress should be secured to that end. The Committee therefore recommends that information concerning products and two or three facts naturally related to this subject, involving no additional expense and labor, be gathered for the coming biennial inquiry.

81. The Committee recommends that a geographical rather than an alphabetical arrangement be followed in the reports of agriculture and that these reports be published in three volumes entitled, respectively, North, South, and West.

82. The Committee recommends that so far as possible the geographic arrangement be followed also in the publication of the reports for population and manufactures.

83. For the reason that the countries of birth reported in 1920 for foreign-born white persons and for the foreign-born parents of native white persons are not identical in area, representing for the first class *post-war* areas and for the other *pre-war* areas, the country of origin of the foreign white stock in 1920 cannot be determined by combining, as in 1910, the countries reported for these two classes of the white population; and inasmuch as comparison of the returns for 1920 and 1910 on the basis of country of origin seems desirable, the Committee approves the plan, submitted by the Chief Statistician for Population, for making a further classification of the foreign-born white population according to the birthplace of the father, as affording approximately correct results on the *pre-war* basis for combination with similar results already tabulated for the foreign-born parents of the native white population, in substantial conformity to the terms of Resolution 51. This recommendation relates only to the present census. The Committee is of the opinion that this complex scheme of tabulation should not be carried into later censuses.

84. The Committee recommends that the Fourteenth Census report on occupation statistics include comparable Thirteenth Census statistics on the age of child workers and on the marital condition of female workers, to the extent that it is found practicable to compile such statistics without delaying the completion of the report beyond the close of the census period.

85. The Committee recommends the publication in the population report of a presentation, by states and for principal cities, of the number of blacks and mulattoes as reported on the population schedules for 1920. The Committee is of the opinion that the marked increase in the proportion of mulattoes in 1910, as compared with the returns for preceding censuses, may have been due to the employment of a large number of colored enumerators in 1910; and the Committee further recommends that, so far as practicable, the returns for 1910 be compared with those for 1920, particularly for those areas in which considerable numbers of colored enumerators were employed in 1910, and that the proper text statement be made in connection with the presentation of these statistics in the population report.

86. The Committee recommends that in view of the relative unimportance of small establishments which have heretofore been included in the Census, establishments with a product of less than $5,000 be omitted from the biennial canvass of manufactures with respect to the general inquiries carried on the manufactures schedule, and that the Director of the Census make such inquiries of establishments with a product of less than $5,000 as, in his judgment, may be necessary to develop the total number of such establishments and the total value of products.

87. The Committee recommends that such tabulations of the population of foreign parentage in certain states and large cities be made as will make it possible to calculate death rates upon the basis of the birthplace of mother.

88. The Committee recommends that the Director of the Census authorize the collection of transcripts of certificates of still-births from the official records and the tabulation of the returns. This recommendation is based upon the belief of the Committee that such statistics may be of great value to health officials and physicians and upon the fact that the experience of the Bureau of the Census in getting such statistics in 1918 seems to indicate that they are sufficiently accurate to prove serviceable.

89. The Advisory Committee recommends that the Bureau does not undertake to publish an elaborate mathematical analysis of the structure and movement of population. Such a study would be of interest only to a very small number of special students, and should be undertaken by the Bureau only if fairly certain to be an important contribution to knowledge. Expert opinion, the committee finds, is not agreed respecting the value of the results that have been reached or are likely to be reached in studies of this kind.

The Committee further recommends, however, that the Bureau should give private investigators in this field of research whatever assistance may be feasible.

90. In connection with Resolution No. 80, recommending a considerable curtailment in the scope of the biennial census of manufactures as compared with previous censuses, the Committee has given consideration to the numerous suggestions made to the Secretary of Commerce and the Director of the Census that a census be taken of distribution as shown by the operations of wholesale and retail merchants. It is true that the mercantile transactions of the country are to a certain extent reflected by the conditions of the primary manufacturing trades. Nevertheless, commerical transactions do not always keep pace with manufacturing industries, and under certain conditions manufacturing industries are not in harmony with distribution factors.

From a consideration of the entire subject, the Committee is impressed with the importance of not only collecting data at stated intervals for the "products of manufacturing industries," as required by the Act of March 3, 1919, but taking also a complete census of all manufacturing and mechanical trades, as well as of the mercantile transactions of the entire country.

The Committee therefore recommends that the Secretary of Commerce take steps to bring this subject to the attention of Congress with the hope that legislation be enacted authorizing the Director of the Census to make a complete census of industrial and mercantile establishments of the United States for some recent year and appropriating a sum of money sufficient for that purpose.

# APPENDIX II

## PROGRESS OF CENSUS WORK IN 1921

### Population

By the close of the year 1920, the enumeration of population having been made as of January 1 of that year, work had been completed with respect to (1) the count and announcement of the population by states, counties and minor civil divisions, and for all cities and other incorporated places (these announcements, commencing in February, were completed in October. A preliminary statement of the population of the entire country went to press October 7); (2) state bulletins, showing the number and distribution of inhabitants (13 bulletins issued, the remainder in press); and (3) the editing of the returns on the population schedules and the punching and machine verification of the population cards.

Work had been commenced on the first sort and first and second counts of the population cards (completed early in 1920), the classification of the occupation returns and the punching of the occupation cards.

The work performed during the year was substantially in accordance with the program previously outlined, and exceedingly satisfactory progress has been made during the year 1921.

The program for the first half of 1921 called for the following items of work: To complete the first sort and the first and second counts of the population cards, from which are derived statistics showing the composition and characteristics of the population for the second series of state bulletins; to begin and complete the successive sorts and counts of the population cards needed to supply the detailed statistics for the various subjects to be covered by the general report; to complete the classification of the occupation returns and the punching of the occupation cards; to rearrange the tabular matter contained in the first series of state bulletins for publication, with appropriate summary tables and explanatory text, as Volume I of the Fourteenth Census Reports; to prepare copy for the second series of state bulletins, and to complete the publication of preliminary statements for states and cities, showing the distribution of the population according to color or race and sex.

The first and second counts of the population cards were completed in February and the third count in June, but the work on the three remaining counts was retarded somewhat in order to advance the work on the occupation report. The verification of the occupation cards was begun in March and the first sort and first count in March and May, respectively, and this necessitated carrying the last of the machine tabulations with respect to population into the last half of the year. The classification of the occupation returns was completed in April, punching of the cards the first week in May.

Rearrangement of the tables of the first series of state bulletins for Volume I was begun in January and by the close of June had been substantially completed. Volume I was issued August 30.

It was the purpose also to have all the copy for the second series of state bulletins in the hands of the printer by the close of the fiscal year. The work was delayed on account of the preparation of a series of tables showing, for the United States and each state, the distribution of the foreign-born white population by country of birth, specially requested for the early use of Congress. Despite this interruption copy was sent to the printer before the end of June for 41 of these bulletins, and during July for the remaining 11.

Preliminary announcements showing the distribution of the population by color or race and sex for individual states and cities were continued, and final summaries for the United States, by states, were given to the press in the latter part of June. Press statements on country of birth were issued in April by states for the United States.

The three remaining counts of the population cards were completed in October, and the second count of the occupation cards early in November. Work was also begun on the tabulation of certain supplementary data for use in the population and occupation reports and by the division of vital statistics. This work was not originally provided for, but it is hoped it will be completed in January, 1922.

Completion in November of publication of the second series of state bulletins released all for use in Volume III. This volume includes a separate section for continental United States, which summarizes the statistics presented in the several state sections and reproduces the statistics for states and large cities for comparative purposes, and also includes statistics for the six outlying possessions covered by the 1920 census.

Of the subjects to be included in Volume II, constituting the general report on population, the copy for three subjects (color or race, nativity, and parentage; sex distribution; and dwellings and families) was sent to the printer in October and November and that for three other subjects (age distribution, marital condition, and school attendance) was transmitted in December. It is also expected that the copy for six other subjects (illiteracy, state of birth, country of birth, year of immigration, voting age and citizenship, and inability to speak English) will be released in January and February and for the two remaining subjects (country of origin and mother tongue) by the end of March.

The tables relating to ownership of homes, as shown by the returns on the population schedule, have also been completed and turned over for use in the special report on mortgages.

Preliminary press announcements were issued during the last half of the year for school attendance, illiteracy, voting age, citizenship, dwellings and families, and ownership of homes, and these will be followed early in 1922 by announcements for age, marital condition, state of birth, and country of birth with respect to citizenship.

The preparation of the tables for Volume IV, relating to occupation, is well advanced. Separate reports for Alaska, Porto Rico and Hawaii have been issued, or are in press, or about one fourth of the occupation report will be in the printers' hands by January, 1922. It is expected there will be completed by the end of May the tables giving the distribution by color or race and age for all gainful workers and separately for child workers, and also the detailed presentations for states and principal cities, and by the end of June the tables giving the marital condition of women at work. If these expectations are fulfilled, the Bureau, for the first time in the history of the decennial census, will have completed and sent to the printer within the allotted period a comprehensive report on occupation, in addition to the preparation and publication of the three customary reports relating to the general population.

There has also been transmitted for printing the first section of the Abstract of the Fourteenth Census relating to the number and distribution of inhabitants and comprising 19 tables.

The condition of the population work at the close of the year may be summarized as follows:

All the machine tabulation for both population and occupations was completed. In addition the tabulation of certain supplementary data will probably be finished by the close of January, 1922.

Volume I of the Fourteenth Census Reports was published August 30.

For Volume II the work is well under way. One section has been published in bulletin form, copy for 4 more is in the hands of the printer, and the work is progressing satisfactorily on the remaining 9 sections.

Volume III is in the hands of the printer, and will probably be published about February 1, 1922.

Volume IV (Occupations) will be in press before the close of the census period.

## AGRICULTURE

The enumeration for all branches of the census of agriculture, including irrigation and drainage, was practically finished early in 1920. The editing of farm schedules and the punching of cards for the main tabulations had been completed. Punching of the county-total cards, the machine sorting and tabulation, and the preparation and distribution of county and state press summaries were under way.

The repunching of the fruit cards for California and Florida was completed in February. The general sorting and tabulation and the checking and completion of result slips were finished in June. By the end of June copy had been sent to the printer for 42 state bulletins in all; and press summaries had been issued for 39 states (three summaries for each state) and 2,039 counties, including those issued in 1920 for 10 states and 604 counties; the total cards had been punched for 41 states, including those punched in 1920; and about fifteen per cent of the table forms had been completed. The editing of schedules was completed for irrigation in March and for drainage in May; the card punching was finished for irrigation in March and for drainage in June; and by the end of June manuscript had been sent to the printer for 14 state bulletins on irrigation and 15 on drainage.

The checking, computing, and critical examination of the final result slips for state bulletins and the punching of the state total cards were completed in August. The last of the state bulletins was completed in September, and the United States summary bulletin in October. This bulletin contains all the material presented in preliminary form in the series of United States press summaries, including the results of the minor tabulations which were not completed in time for inclusion in the state bulletins, and provides a comprehensive summary of the census of agriculture which it is believed will prove very useful during the several months which must yet intervene before the final reports are ready for distribution.

A special bulletin on farm vegetables, showing the acreage in vegetables for important counties, together with summary tables for the various kinds of vegetables, and a special bulletin on cattle, swine, and poultry were transmitted for printing in December.

The series of state bulletins on irrigation and drainage were completed in August and October, respectively; the United States summary bulletins on irrigation and drainage were completed in September and November, respectively; and the preparation of tables and text for the general reports on these subjects was commenced in November.

Nearly all the state bulletins have been revised and plated, ready for inclusion in Volume VI of the final reports. The states will be grouped geographically into three sections and the bulletins for each section bound in a separate volume as a part of Volume VI. Part I, The North, will cover the New England, Middle Atlantic, East North Central, and West North Central divisions, comprising a total of 21 states; Part II, The South, will cover the South Atlantic, East South Central, and West South Central Divisions; embracing a total of 16 states and the District of Columbia;

and Part III, The West, will cover the Mountain and Pacific Divisions, with a total of 11 states, together with the outlying possessions of Alaska, Hawaii, Porto Rico, Guam, American Samoa, and the Panama Canal Zone. The United States summary will be included in each of these parts, thus providing a convenient means of comparing one state with another, and also supplying the state figures for the minor topics which were not presented in the individual state bulletins.

The table forms have been prepared for Volume V; the general report and analysis, and the work of making up these tables, including the computing of the required percentages and averages, is well advanced. It is now planned to send all the copy for the final report to the printing office before March 15, 1922.

The series of state bulletins on irrigation, covering 19 states, is complete, the summary for the United States has been issued, and the final report on irrigation is in the hands of the printer.

The series of state bulletins on drainage covers 29 states. All these bulletins are printed or in press, and the final report on drainage is in course of preparation. It should be ready for printing by March 1.

The following summary shows briefly the condition of the agricultural work at the close of the year:

The machine tabulation has been completed.

All the state bulletins and the United States summary bulletins on agriculture, irrigation, and drainage have been completed.

Volume V of the Fourteenth Census Reports, the general report and analysis, is in process of preparation, and it is expected that the last of the copy will be sent to the printer before March 15, 1922.

For Volume VI the work is well advanced, and it is expected that the three parts of this volume—The North, The South, and The West—will be sent to the printer on or before January 15, 1922.

Volume VIII will comprise the final and complete reports on irrigation and drainage. The irrigation report is in the hands of the printer, and the drainage report is in process of preparation and will be sent to the printer about March 1, 1922.

### THE MORTGAGE INQUIRY

In accordance with the Fourteenth Census Act the population schedule contained an inquiry as to whether the home of the person enumerated was owned or rented and, if owned, whether it was free or mortgaged. When the schedules reached the Bureau from the field they were reviewed and letters of inquiry sent out to the owners of all homes, except farm homes, reported as mortgaged, asking for the value of the home, the amount of the mortgage or encumbrance on the census date, the rate of interest, and the original amount of the mortgage.

To December 31, 1920, 2,111,117 letters of inquiry were sent out and 631,150 replies received. Up to the close of November 30, 1921, 5,119,204 letters were sent out, including a number of second and third requests in cases of failure to reply to previous requests, and 3,430,162 replies were received. These are substantially all the replies that will be received, as there are now only a few scattering reports reaching the Bureau.

The tabulation of the reports was begun in April, 1921. The issuance of press announcements for cities having 100,000 inhabitants or more was commenced in May and completed in December. The tabulation for the several states is now in progress, and the issuance of state press announcements was begun in December.

The preparation of the special report on the subject has been begun, and it is the intention to have the copy in the hands of the printer before the close of the decennial census period.

## MANUFACTURES, MINES, AND QUARRIES, AND FORESTRY AND FORESTRY PRODUCTS

The field work for the censuses of manufactures, mines and quarries, and forestry and forest products was completed in 1920. At the end of the year the checking, examination, classification, and editing of the reports were under way and the punching of the cards had been commenced.

The principal items of the program of work for the first half of 1921 comprised the checking of schedules to lists of establishments, the card punching, the commencement of the general tabulations, and the tabulations of detailed statistics of materials and products.

The checking of the schedules to lists of establishments was completed in March. The card punching was completed in July.

The preparation of the industry, state, and city summaries was completed in September. The preparation of the final-result tables for cities has been finished, but those for industries and for states have not yet been brought to completion.

Following the tabulation, summaries were prepared for states by industries, county totals for all industries were computed, and summaries were prepared for cities having 50,000 inhabitants or more by industries and for cities having between 10,000 and 50,000 inhabitants for all industries combined.

Up to December 8 the manuscript for the final bulletins for 30 states and the District of Columbia, for 13 bulletins covering mining and quarrying operations in 44 states, and for 3 bulletins for forest-products industries had been sent to the printer; and the bulletins for 15 states and the District of Columbia had been printed and distributed. The preparation of the remaining bulletins is well under way, and all will be in the hands of the printer early in 1922. The series of industry bulletins will cover about fifty of the most important industries.

The condition of the work on the manufactures, mines and quarries, and forestry and forest products inquiries at the close of the year is shown by the following summary:

The machine tabulation has been brought very nearly to completion.

The preparation and issuance of industry, state, and city summaries have been completed.

The preparation of the tables for industries and states is well toward completion.

For Volume VIII little work has yet been done, but it is the intention to have the last of the copy for this volume in the hands of the printer by June 30, 1922.

Volume IX will probably be published about April 30. Most of the state bulletins (which will constitute sections of this volume) have already been sent to the printer, and the remainder will be transmitted early in 1922.

For Volume X the work is progressing satisfactorily, although thus far only a few of the industry bulletins (which will constitute sections of this volume) have actually been printed. It is not anticipated that there will be any difficulty in completing the series some time prior to June 30, 1922.

For Volume XI the work is well under way, and it is expected that the last of the copy will go to the printer before June 30, 1922.

# COMPARISON OF CHANGES IN THE VALUE AND THE VOLUME OF FOREIGN TRADE

BY LAWRENCE B. MANN, *Federal Reserve Board*

Ever since the exports of war materials to Europe began in 1915 there has been much discussion as to how much of the great increase in the value of American foreign trade was due to increase in prices, and how much reflected the increased volume of shipments.

The Federal Reserve Board is now making studies of post-war trade conditions in order to determine the relative importance of changes of prices and changes in volume of shipments upon the value of exports and imports. For this purpose monthly exports of 29 commodities and monthly imports of 27 commodities have been studied. Each of these two major groups of commodities was divided into three minor

| Date | Raw materials (12 commodities) | | Producers' goods (10 commodities) | | Consumers' goods (7 commodities) | | Total exports (29 commodities) | |
|---|---|---|---|---|---|---|---|---|
| | Value | Volume | Value | Volume | Value | Volume | Value | Volume |
| 1919 | | | | | | | | |
| Jan. | 219.6 | 98.2 | 382.4 | 159.0 | 405.0 | 186.4 | 268.1 | 124.7 |
| Feb. | 147.8 | 68.3 | 322.9 | 125.9 | 405.7 | 175.2 | 211.0 | 99.0 |
| Mar. | 152.2 | 67.3 | 350.7 | 139.3 | 481.3 | 202.3 | 230.7 | 106.1 |
| Apr. | 162.5 | 76.0 | 382.7 | 166.9 | 606.9 | 264.9 | 264.6 | 129.3 |
| May | 167.0 | 78.9 | 311.0 | 137.7 | 435.0 | 192.9 | 229.5 | 111.4 |
| June | 251.1 | 114.8 | 520.7 | 247.1 | 761.6 | 315.1 | 369.8 | 174.7 |
| July | 185.2 | 84.0 | 310.7 | 147.9 | 415.8 | 172.7 | 239.2 | 110.9 |
| Aug. | 212.6 | 94.9 | 349.5 | 168.8 | 393.5 | 161.6 | 258.1 | 117.5 |
| Sept. | 174.7 | 82.1 | 368.6 | 166.9 | 340.8 | 142.4 | 222.2 | 104.1 |
| Oct. | 186.4 | 82.1 | 349.7 | 148.1 | 358.3 | 150.6 | 232.4 | 104.4 |
| Nov. | 312.0 | 116.2 | 320.7 | 135.7 | 369.0 | 153.5 | 323.6 | 126.9 |
| Dec. | 289.8 | 104.6 | 258.5 | 113.9 | 350.8 | 143.1 | 298.7 | 114.6 |
| 1920 | | | | | | | | |
| Jan. | 314.7 | 108.7 | 322.1 | 134.9 | 304.3 | 116.2 | 313.4 | 112.9 |
| Feb. | 232.6 | 81.9 | 305.6 | 122.4 | 342.1 | 136.8 | 259.4 | 98.7 |
| Mar. | 304.0 | 106.0 | 357.4 | 148.8 | 477.5 | 186.0 | 341.2 | 128.9 |
| Apr. | 228.7 | 79.5 | 359.3 | 147.5 | 444.3 | 169.1 | 280.2 | 107.1 |
| May | 208.3 | 73.5 | 352.7 | 150.4 | 509.1 | 205.5 | 277.0 | 111.9 |
| June | 185.1 | 64.9 | 315.3 | 126.4 | 393.8 | 151.5 | 235.3 | 91.1 |
| July | 239.2 | 78.1 | 380.0 | 164.4 | 354.8 | 142.3 | 272.8 | 101.3 |
| Aug. | 235.3 | 78.7 | 334.9 | 135.4 | 253.7 | 94.7 | 247.1 | 87.7 |
| Sept. | 257.6 | 82.5 | 300.4 | 119.7 | 259.7 | 94.0 | 261.6 | 88.6 |
| Oct. | 331.2 | 118.7 | 391.4 | 152.2 | 327.2 | 124.4 | 335.4 | 123.1 |
| Nov. | 269.9 | 111.1 | 306.0 | 121.8 | 309.3 | 111.6 | 280.4 | 112.2 |
| Dec. | 260.7 | 122.4 | 458.5 | 186.0 | 311.8 | 123.3 | 287.0 | 128.4 |
| 1921 | | | | | | | | |
| Jan. | 199.8 | 105.2 | 466.1 | 187.9 | 277.9 | 126.0 | 236.8 | 117.6 |
| Feb. | 158.9 | 91.0 | 325.6 | 141.0 | 219.3 | 116.4 | 184.2 | 101.6 |
| Mar. | 132.3 | 78.2 | 244.2 | 104.4 | 205.5 | 122.4 | 155.5 | 91.1 |
| Apr. | 117.4 | 76.6 | 212.1 | 102.7 | 193.2 | 122.5 | 139.6 | 89.9 |
| May | 147.4 | 97.7 | 157.2 | 81.8 | 169.9 | 112.8 | 152.5 | 100.0 |
| June | 151.8 | 107.9 | 135.0 | 74.4 | 199.7 | 135.1 | 159.4 | 111.3 |
| July | 153.6 | 111.6 | 118.6 | 68.3 | 195.7 | 131.8 | 158.7 | 112.5 |
| Aug. | 195.4 | 142.7 | 118.2 | 68.1 | 227.9 | 164.1 | 195.1 | 140.9 |
| Sept. | 151.9 | 115.7 | 129.3 | 79.1 | 199.4 | 147.5 | 159.0 | 119.9 |
| Oct. | 183.3 | 121.7 | 120.7 | 83.5 | 153.3 | 119.2 | 172.4 | 117.6 |
| Nov. | 137.3 | 95.1 | 126.6 | 83.7 | 146.3 | 108.6 | 138.1 | 97.3 |
| Dec. | 129.8 | 93.8 | 115.2 | 74.1 | 140.8 | 106.5 | 126.9 | 95.0 |

groups—raw materials, producers' goods, and consumers' goods. A comparison was then made between changes in value and changes in volume in each of these six classes.

For purposes of combination the volume of shipments of each commodity was translated into dollars by multiplying by its average wholesale price in the United States in 1913. The combined values thus obtained were converted into index numbers by making the average monthly value in 1913 equal to 100. The value of exports or imports of each commodity, as shown by the Department of Commerce, were then converted into a comparable set of index numbers by adding the values of the commodities in each group and taking their average monthly value in 1913 as a base. Comparisons of the sets of index numbers thus obtained are shown for groups of exports in the preceding table.

Changes in value and volume of 27 imported commodities based on average monthly figures for 1913 follow:

| Date | Raw materials (10 commodities) | | Producers' goods (12 commodities) | | Consumers' goods (5 commodities) | | Total imports (27 commodities) | |
|---|---|---|---|---|---|---|---|---|
| | Value | Volume | Value | Volume | Value | Volume | Value | Volume |
| 1919 | | | | | | | | |
| Jan. | 144.1 | 88.5 | 207.4 | 143.3 | 120.0 | 95.5 | 162.6 | 109.1 |
| Feb. | 165.6 | 94.9 | 258.9 | 180.2 | 121.6 | 97.9 | 191.3 | 125.6 |
| Mar. | 182.8 | 109.2 | 269.4 | 223.0 | 226.5 | 165.1 | 222.2 | 158.6 |
| Apr. | 228.2 | 125.9 | 305.2 | 237.7 | 175.8 | 137.1 | 246.5 | 167.4 |
| May | 282.0 | 161.4 | 353.0 | 242.8 | 225.2 | 178.1 | 297.3 | 193.0 |
| June | 292.5 | 171.4 | 243.1 | 167.2 | 197.3 | 144.3 | 257.1 | 165.4 |
| July | 311.8 | 171.7 | 281.6 | 209.1 | 320.0 | 204.4 | 302.4 | 190.3 |
| Aug. | 323.8 | 169.9 | 167.1 | 113.8 | 272.6 | 153.0 | 257.6 | 147.3 |
| Sept. | 487.7 | 245.3 | 281.9 | 189.2 | 326.9 | 169.8 | 383.6 | 213.1 |
| Oct. | 390.3 | 196.8 | 285.9 | 201.9 | 254.3 | 137.0 | 327.5 | 188.8 |
| Nov. | 426.2 | 196.1 | 282.5 | 213.9 | 265.0 | 143.5 | 344.6 | 193.8 |
| Dec. | 340.6 | 158.9 | 236.4 | 194.2 | 244.5 | 144.4 | 285.2 | 169.0 |
| 1920 | | | | | | | | |
| Jan. | 452.2 | 206.1 | 395.6 | 244.8 | 272.3 | 152.9 | 398.7 | 211.1 |
| Feb. | 411.4 | 173.2 | 498.5 | 289.4 | 225.3 | 126.9 | 408.8 | 206.9 |
| Mar. | 431.9 | 192.7 | 548.1 | 338.3 | 302.1 | 173.0 | 450.2 | 241.2 |
| Apr. | 375.2 | 173.9 | 482.2 | 262.5 | 337.6 | 193.7 | 407.1 | 208.6 |
| May | 305.9 | 127.5 | 501.0 | 227.2 | 181.5 | 108.1 | 353.8 | 159.6 |
| June | 352.6 | 157.3 | 789.6 | 257.2 | 252.4 | 149.2 | 492.6 | 191.4 |
| July | 275.8 | 121.0 | 819.7 | 256.8 | 288.0 | 168.3 | 475.2 | 176.9 |
| Aug. | 259.8 | 122.3 | 750.1 | 256.3 | 248.5 | 160.0 | 435.4 | 176.0 |
| Sept. | 192.8 | 101.3 | 424.4 | 165.3 | 170.1 | 120.5 | 272.6 | 127.1 |
| Oct. | 151.6 | 89.1 | 298.2 | 131.5 | 167.5 | 120.4 | 207.7 | 109.2 |
| Nov. | 140.8 | 86.3 | 335.8 | 166.4 | 128.7 | 102.4 | 209.2 | 117.3 |
| Dec. | 119.5 | 79.4 | 262.6 | 133.0 | 95.1 | 91.6 | 166.9 | 100.4 |
| 1921 | | | | | | | | |
| Jan. | 99.2 | 74.5 | 181.6 | 130.8 | 112.3 | 123.9 | 131.5 | 102.6 |
| Feb. | 144.1 | 118.2 | 201.7 | 143.5 | 117.6 | 135.5 | 160.1 | 130.0 |
| Mar. | 154.6 | 160.7 | 249.7 | 177.5 | 148.9 | 178.9 | 188.0 | 169.7 |
| Apr. | 179.7 | 153.4 | 247.7 | 177.7 | 158.9 | 185.1 | 200.5 | 167.2 |
| May | 137.1 | 98.7 | 172.2 | 150.2 | 140.3 | 162.1 | 150.4 | 127.3 |
| June | 132.6 | 94.5 | 137.3 | 152.5 | 111.7 | 130.4 | 130.4 | 120.9 |
| July | 135.3 | 99.3 | 115.7 | 126.5 | 112.3 | 121.4 | 124.0 | 112.6 |
| Aug. | 160.3 | 116.7 | 146.3 | 165.0 | 117.3 | 129.8 | 147.3 | 136.0 |
| Sept. | 134.1 | 102.8 | 103.7 | 137.8 | 97.6 | 99.4 | 116.4 | 114.6 |
| Oct. | 120.5 | 96.2 | 117.5 | 173.5 | 115.0 | 116.5 | 118.4 | 126.9 |
| Nov. | 147.2 | 115.1 | 131.8 | 199.5 | 149.8 | 149.2 | 142.1 | 150.6 |
| Dec. | 200.7 | 133.0 | 129.8 | 218.9 | 169.4 | 164.8 | 169.3 | 168.7 |

The volume of merchandise exports of these selected commodities was slightly higher in January, 1919, than in the average month of 1913, while the total value of such exports was over two and one-half times as great. This divergence between the relatives of volume and value of exported merchandise tended to become greater until September, 1920. From October, 1920, to September, 1921, however, the value and volume series have shown a marked tendency to return to their 1913 relationship. Raw materials were first affected by this curtailment in relative values, but consumers' goods and producers' goods very soon followed the same course. In October, 1921, the value of raw materials once more showed a relative increase as compared with the volume, while consumers' goods and producers' goods registered a similar movement in November.

The volume of the selected group of imports in January, 1919, was only slightly larger than in the average month of 1913, while their value was over 50 per cent greater. This difference between relative volume and value of imports for the group as a whole tended to increase until July, 1920, but after that month declined rapidly, until the volume on a 1913 base in October, 1921, was greater than the value. This decline started first in the consumers' group in October, 1919; it was registered by raw materials commencing with June, 1920, and by producers' goods commencing with August, 1920. It was finally entirely checked in November, 1921, but average prices of consumers' goods had already commenced to show a reverse movement in July, 1921.

The value of both exports and imports increased more rapidly than their volume during 1919 and the first half of 1920. Since the summer of 1920, however, these values have shrunk very rapidly, and in recent months values of selected imports are relatively lower than in 1913, while values of a selected group of exports are only about 40 per cent higher than they would have been at 1913 prices.

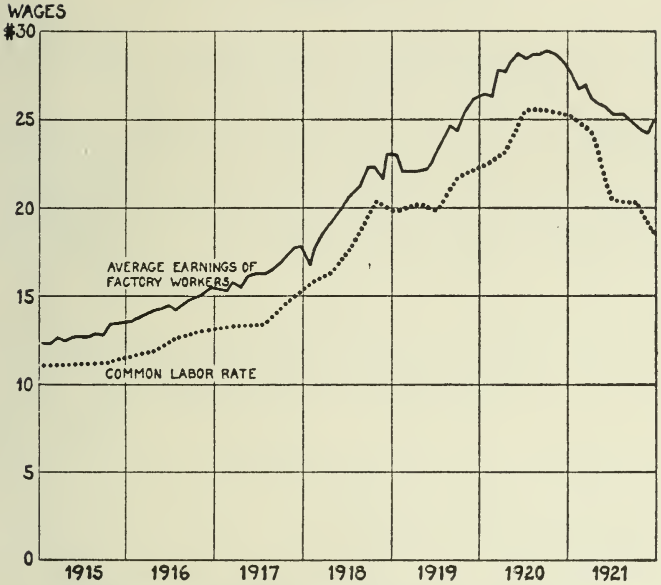
## INDEX NUMBERS FOR THE WAGES OF COMMON LABOR

By W. Randolph Burgess

The Federal Reserve Bank of New York has recently undertaken the compilation of an index number for the rate of pay for common labor in the second Federal Reserve District. Figures have been secured from sixteen concerns and occupations in the district employing about 20,000 workers, showing by quarters since 1913 the hiring rate for male unskilled laborers in terms of average hourly wages. Similar figures were also secured showing the average number of hours in the working week, so that figures can be used on an hourly, daily, or weekly basis. The returns cover building laborers, railroad laborers, and laborers in a variety of industries.

Index numbers have been computed from the reports in the form of simple averages of rates shown by individual concerns. The number of concerns from which returns have been requested has been kept small in order that the figures may be secured rapidly at somewhat frequent intervals from the same number of establishments. The stability of the figures, in spite of the small number of firms, is assured by the homogeneous character of the group reported. Restricting the figures to the hiring rate for male common labor results in an exceedingly narrow spread in the distribution shown by the returns. The hiring rate for the last return in December was identical in the case of eight establishments. The probable error is thus reduced to a minimum in spite of the small number of concerns reporting.

The index for the rate of wages of common labor was undertaken for two major reasons. In the first place the studies of Professor H. L. Moore, of Columbia University, in his *Laws of Wages,* and the unpublished studies of Dr. Ralph G. Hurlin, of the Russell Sage Foundaation, indicate that the wage of common labor is an exceptionally good indicator of the general level of wages, and that other wages in the long run tend to bear a direct relation to the wages of common labor. In the second place there has been no satisfactory current index up to this time of the changes in wage rates. The best wage indexes that have been available have been those complied by the New York State Department of Labor for the average weekly earnings in industrial establishments in New York state, and the index prepared by the Federal Reserve Bank of New York from figures published by the United States Bureau of Labor Statistics for the average weekly earnings of workers in factories in thirteen representative industries throughout the United States. Although these indexes indicate the general trend of wage changes with a considerable degree of accuracy, they are affected by changes in employment. It is notable, for example, that the average earnings of workers in New York state factories have remained somewhat higher than would have been expected because in the recent period of industrial unemployment the least efficient and the poorest paid workers were released first and the more efficient and better paid workers were retained. The average earnings figures also reflect part-time employment. It is impossible to tell from the published figures how fully these different elements affect the final indexes.



Average Weekly Earnings of Factory Workers in New York State and the Average Weekly Wage Rate for Male Common Labor in the Second Federal Reserve District

In the accompanying diagram the movement of the common labor rate is compared with the index of average weekly earnings in New York state factories prepared by the New York State Department of Labor. The average earnings of factory workers have run slightly higher than the common labor rate, partly because they include the wages of some skilled and semi-skilled workers, although this factor is in part offset because they include the wages of women as well as of men. The common labor rate began its decline slightly earlier than average earnings of factory workers, and has declined much more rapidly. The common labor index shows somewhat fewer small fluctuations than the average earnings index, partly because it is on a quarterly rather than a monthly basis, and partly because of the effect on the average earnings index of employment conditions. The figures for the common labor index are presented in the following table:

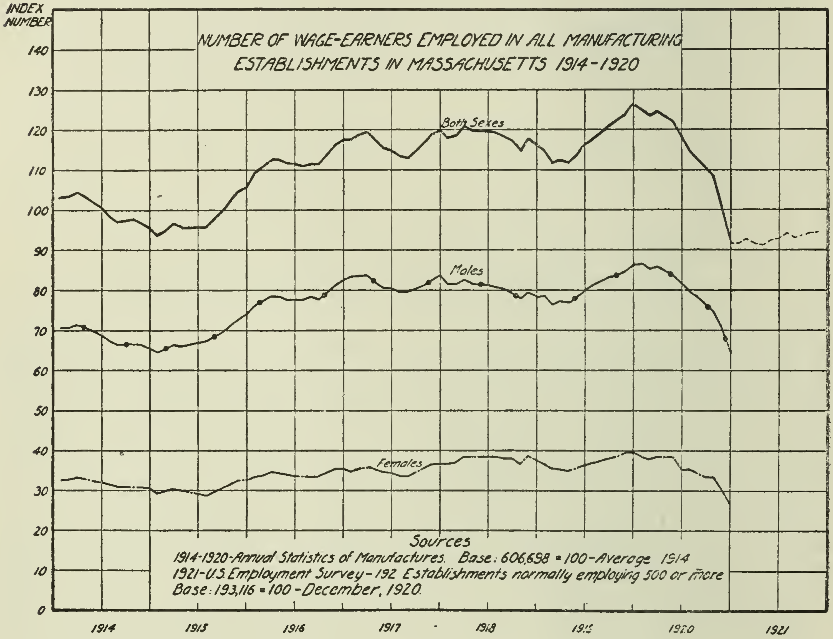
AVERAGE WEEKLY EARNINGS OF UNSKILLED LABOR

| | January | April | July | October |
|---|---|---|---|---|
| 1914 | ..... | ..... | $10.92 | $10.92 |
| 1915 | $11.10 | $11.10 | 11.10 | 11.22 |
| 1916 | 11.52 | 11.82 | 12.54 | 12.96 |
| 1917 | 13.08 | 13.26 | 13.44 | 14.64 |
| 1918 | 15.60 | 16.32 | 17.88 | 20.28 |
| 1919 | 19.80 | 20.10 | 19.98 | 21.84 |
| 1920 | 22.44 | 23.16 | 25.50 | 25.50 |
| 1921 | 25.14 | 24.36 | 20.64 | 20.40 |
| 1922 | 18.06 | ..... | ..... | ..... |

# NUMBER OF WAGE-EARNERS IN MANUFACTURING ESTABLISHMENTS IN MASSACHUSETTS, 1914–21

In the December, 1921, issue of this Journal, there appeared an article[1] by Dr. Ernest S. Bradford in which was included a chart with accompanying text having reference to fluctuations in the number of employees in representative factories in the states of New York and Wisconsin during the period 1914–21. The interest in the subject of unemployment at this time is so great that it justifies the publication of the two accompanying charts which will serve to supplement the chart in Dr. Bradford's article.

CHART I.



NUMBER OF WAGE-EARNERS EMPLOYED IN ALL MANUFACTURING ESTABLISHMENTS IN MASSACHUSETTS 1914-1920

Sources
1914-1920-Annual Statistics of Manufactures. Base: 606,698 = 100-Average 1914
1921-U.S. Employment Survey-192 Establishments normally employing 500 or more
Base: 193,116 = 100-December, 1920.

Chart I shows variations in the number of wage-earners employed in *all* manufacturing establishments in Massachusetts during the period 1914–20, as determined by the annual censuses of manufactures taken in that state. Separate graphs are shown for male and for female wage-earners. The census of manufactures covering the year 1921 will not be completed for several months, and it is therefore not possible to furnish data covering *all* manufacturing establishments in the state for that year. The State Department of Labor and Industries, however, has coöperated with the United States Employment Service in obtaining employment data from 192 manufacturing establishments in Massa-

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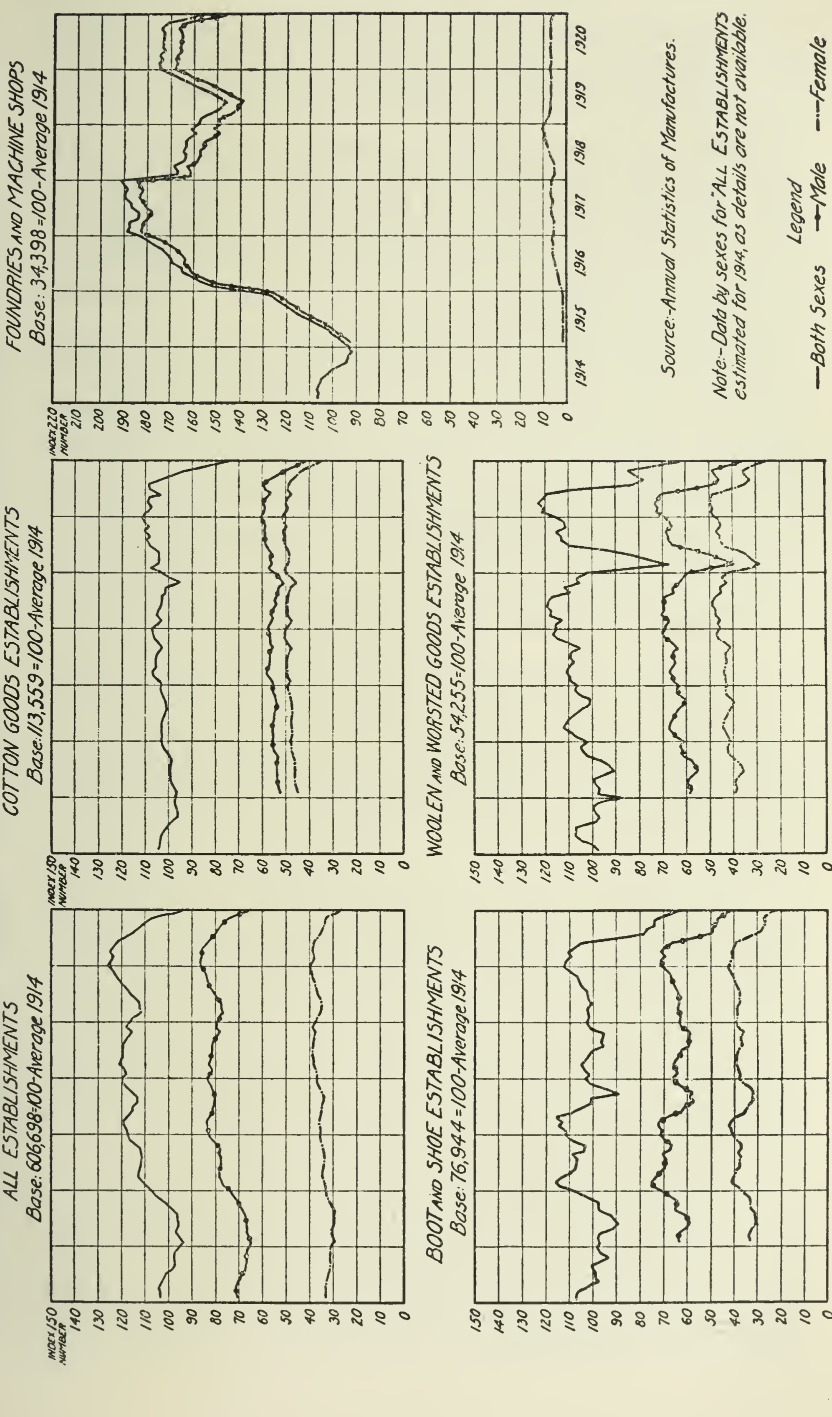
[1] "Methods Used in Measuring Unemployment."

CHART II.

NUMBER OF WAGE-EARNERS EMPLOYED IN MANUFACTURING ESTABLISHMENTS IN MASSACHUSETTS 1914-1920



Source:—Annual Statistics of Manufactures.

Note:—Data by sexes for "ALL ESTABLISHMENTS" estimated for 1914, as details are not available.

chusetts, normally employing 500 or more, and covering in December, 1920, 193,116 wage-earners. The dotted portion of the graph (both sexes) for the year 1921 represents the trend of employment in these 192 representative establishments.

If comparison is made with the chart prepared by Dr. Bradford it will be found that there is a very close correspondence in the fluctuations of the graphs for the states of New York, Wisconsin, and Massachusetts. This fact is of particular importance in that it indicates that whether or not the data cover merely a large number of *representative* establishments, as in the case of New York and Wisconsin, or *all* manufacturing establishments, as in the case of Massachusetts, the index numbers are directly comparable.

Chart II includes graphs for the four principal industries and a reproduction, on the same scale, of the chart for all manufacturing establishments. It will be noted that the fluctuations of the graphs representing employment in the *several* industries during the period 1914–20 vary widely from the fluctuations of the graphs representing employment in *all* industries, although in general it may be said that war-time demands and the demand for manufactured products during the latter part of 1919 and the early part of 1920 were reflected in the employment figures for each of the industries.

ROSWELL F. PHELPS
Massachusetts Department of Labor and Industries

## MEDIANS OF WOMEN'S EARNINGS IN FOUR STATES

The Women's Bureau of the United States Department of Labor has recently completed the field work on the fourth of a series of investigations of wages of women in various states. The investigations were undertaken with several different aims in view, with resulting complications in the methods of treating the material.

It is not the policy of the Women's Bureau to go into any state to make this sort of survey without a definite invitation from state authorities or from organizations prominent enough to be able to guarantee adequate coöperation and a satisfactory use of the material. Thus the investigation in Kansas was made at the request of the State Industrial Commission, which desired information upon which to base wage awards. In Georgia the investigation was made at the request of several different organizations, including the State Federation of Women's Clubs and the League of Women Voters; in Rhode Island, at the request of the Governor and the State Consumers' League; and in Kentucky, at the request of the Governor and the State Federation of Women's Clubs.

To present figures which will fill the needs of organizations such as these is one of the functions of the Women's Bureau, but an equally important function is to add to the rather scant statistical material which is now available regarding wages of women in industry. The satisfactory adjustment of these two functions presents many difficulties from the standpoint of the person interested in statistics.

The following figures give the outstanding facts as disclosed by the material gathered in the four states:

MEDIAN WEEKLY EARNINGS OF WOMEN IN ALL INDUSTRIES INVESTIGATED

| State | Median earnings | No. of women reporting | Date of investigation |
|---|---|---|---|
| Kansas | $11.80 | 4,329 | June 1919–June 1920 |
| Georgia | 12.20 (white)<br>6.20 (colored) | 6,566 (white)<br>1,554 (colored) | Oct. 1920–Apr. 1921 |
| Rhode Island | 16.85 | 7,780 | Oct. and Nov. 1920 |
| Kentucky (preliminary figures) | 11.05 (white)<br>8.30 (colored) | 7,840 (white)<br>1,253 (colored) | Sept., Oct., and Nov. 1921 |

The figures from which these medians were computed were the actual amounts of money received by the women according to the record on the pay-roll at the time of the investigation, or on the pay-roll for a week in which a representative number of hours had been worked in cases where the current pay-roll covered a week during which hours had been abnormal.

It is readily seen that the amounts quoted—without correlation with many other factors—by no means tell the entire story. In the detailed reports on wages careful correlations are made of the relation between wages and such factors as the type of industry, period of the investigation, actual hours worked, actual hours in relation to scheduled hours, period of unemployment, age, experience, race, and, where available, cost of living. Thus far, because of the many different industries included in each investigation, it has not been practicable to discuss the relation between wages and occupation.

In preparing such wage material the Women's Bureau must steer between the Scylla and Charybdis of presenting figures too complicated statistically for easy comprehension and use for publicity and educational purposes, or with so few correlations that they are not accurate. In other words, "accurate statistics" are an essential requirement of the type of report issued by the Bureau, but "human statistics" are an essential requirement of the kind of use to which the reports are put.

The median, such as those quoted, of the actual amounts earned during one representative week for specified industries and for all industries is naturally the figure most easily understood and most adaptable to publicity and other general statements. Even with this simple figure, however, it is necessary to interpret the word "median" into terms of "one half received less, and one half more." If the story, or as much of it as possible, must be told in a few paragraphs of words of one syllable, the median of the actual amounts earned during one week seems to be the figure which is most nearly representative of conditions throughout the state, for several different reasons. First: The week for which pay-roll figures are taken is carefully selected in each plant so as to be representative of the normal schedule with regard to hours. Second: The week's earnings are recorded for every woman employed in the plant, thus eliminating much chance of an unusual proportion of women who have worked part-time. That a number of women who have worked only part-time should be included in the record is inevitable, but as every industry has many employees who on occasions work part-time, from necessity or from choice, a rate which includes only full-time workers would be no more accurate than a rate which includes both. Third:

A median rate is much less affected than an average by the extreme items under consideration, and therefore indicates more accurately the general situation. Fourth: From the standpoint of the woman worker who has to meet a weekly bill for board and lodging and other expenses, the important thing is the amount actually earned during a week. Few wage-earners of the type included in these investigations have a reserve fund to draw upon during weeks of scanty earnings. That she is young or inexperienced, that the plant was running only part-time because of lack of orders, that she was ill or that the machine on which she worked had broken down, are conditions which have no effect upon the cost of board and lodging, of clothes, and of carfare for the woman wage-earner.

At present, while women's wages are so likely to be far below any adequate standard of living costs, if there is a choice it is from the woman's point of view that statistics on this subject should be compiled.

For the sake of statistical accuracy, however, and for the benefit of administrative measures both within the industries themselves and in other fields, simple but accurate figures should be available for comparative purposes. These figures should permit of a just evaluation of the standing of different industries with regard to the wage paid their employees. It is obvious that a wage of $15 a week paid to a salesgirl in a 5-and-10-cent store in a country town cannot be compared justly with a wage of $22 a week paid to a machine operator in a city factory manufacturing electrical machinery. In the former case the girl may be young and inexperienced, her duties may require only slight skill or training, and the cost of living in the country is likely to be less than in the city. The machine operator is likely to be older, her earnings may be the result of many years' experience and careful training, the work may be exacting physically and mentally, and her hours may be longer. In such a case can there be said to be a real difference of $7 a week in the earnings of the two girls, and can the electrical appliance factory be rated nearly 50 per cent higher than the 5-and-10-cent store?

An index number of wages which took into consideration some of the above-mentioned factors would be of invaluable assistance in presenting this subject. Until a method is devised for computing such a figure the simple median of weekly earnings seems to be the most graphic and the least liable to be misleading of the various figures presented in the standard wage report.

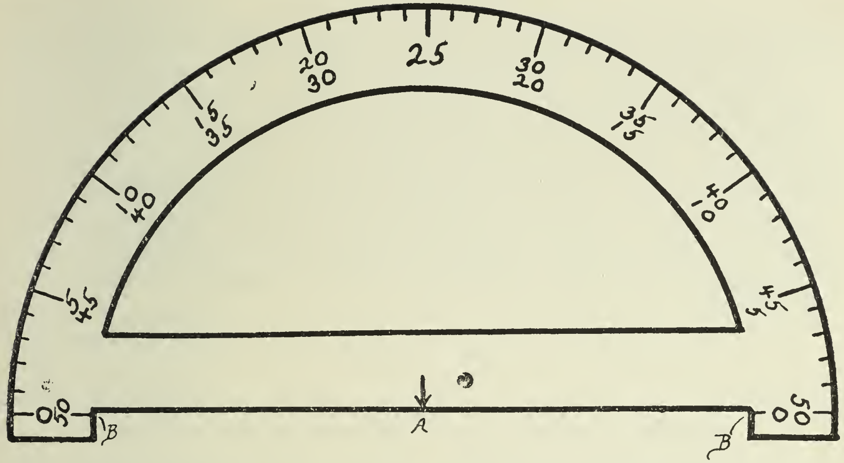
Mary N. Winslow

## A PERCENTAGE PROTRACTOR

### DESIGNED FOR USE IN THE CONSTRUCTION OF CIRCLE CHARTS OR "PIE DIAGRAMS"

For expressing component parts the circle chart or "pie diagram" is admittedly inferior to the composite bar chart. However, there are times when it is advantageous for the sake of popularization to make use of the "pie diagram."

The accompanying cut represents a protractor designed especially for use in the construction of circle charts. The ordinary protractor that is used in subdividing a circle is divided into parts to represent degrees. When attempting to construct a circle divided into sections to show the component parts of a whole—



the so-called "pie diagram"—it has been necessary to reduce the figures to percentages and then multiply by 3.6 to get the relationships in terms of degrees, these values then being laid off by means of the conventional protractor and the radii drawn. By using the protractor here shown it is possible to eliminate the last arithmetic step and to lay off the values directly in terms of percentage. The arrow at "A" should be immediately above the center, and a diameter of the circle should pass through the lines indicated at "B" and "B." The desired percentages as indicated by the protractor are then placed directly on the circle. The protractor may, of course, be used on a circle of any size.

Persons wishing to use such a tool may have the graduations engraved on the back of an ordinary protractor for a reasonable charge.

Frederick E. Croxton

Ohio State University

## THE RESULTS OF THE CENSUS OF CZECHO-SLOVAKIA FOR 1921

This report, fortunately issued in the French language, presents the results of the census of February 15, 1921, with the brevity required for convenient reference, illustrated by four admirable maps delineating the geographical aspects of the enumeration. The Czecho-Slovakia government is showing commendable enterprise in giving publicity to the results of recent statistical investigations, but unfortunately many of the publications are in the Bohemian language, which is practically unknown to the vast majority of readers interested in the social and economic progress of the Czecho-Slovakia Republic. The numerical importance of this new addition to the Congress of Nations is indicated by the fact that the total population was returned as 13,595,816, living in 15,379 administrative subdivisions. The population of Prague (the capital) is given as 676,476, while for the whole of Czecho-Slovakia the density of population is 97 per square kilometer. The population of Prague shows an increase during the period 1910–21 of 59,845, or 9.7 per cent, while for the Republic as a whole the population in 1921 was practically the same as in 1910, or to be exact, 785 less. This apparently stationary condition of the population is, of course, directly attributable to the war and to its resulting loss of life and far-reaching population changes. The population concentration in the capital conforms to similar results for Austria as shown by the census of 1920. The density of population is greatest in the Province of Silesia, where it is 152 compared with 128 for Bohemia, and 119 for Moravia.

The report is a most useful contribution to statistical knowledge at a time when the world's interest is concentrated upon one of the few new nations of Europe in which, apparently, economic conditions are such as to suggest a hopeful and prosperous future.

F. L. Hoffman

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## UNEMPLOYMENT AND THE BUSINESS CYCLE

Out of the President's Conference on Unemployment has come a continuing organization, one of whose tasks is an exhaustive study of the fundamentals of unemployment and the practical measures which can be taken to prevent or mitigate unemployment, together with prompt publication of the facts obtained. Such a study, promptly begun and pressed to early completion, can be made in about six months, and funds for this purpose have now been obtained by Herbert Hoover, Chairman of the Conference.

The committee charged with this study consists of Owen D. Young, of the General Electric Company; Clarence Mott Wooley, of the American Radiator Company; Joseph H. Defrees, President of the U. S. Chamber of Commerce; Matthew Woll, of the American Federation of Labor; Mary Van Kleeck, of the Russell Sage Foundation; and Edward Eyre Hunt, Secretary of the Conference on Unemployment. Wesley C. Mitchell, of the National Bureau of Economic Research, is field director of the study.

The proposed study is not an isolated project, but is part of a comprehensive program to reduce economic waste and to increase production. Active work on this program began last year, and it is now being carried forward by the cordial coöperation of several agencies, public and private. A study of methods for reducing the waste caused by frequently recurring periods of business depression is a necessary part of the program. The importance of making this investigation, and of making it promptly, and the results which may be anticipated, can best be shown by sketching the recent development of the campaign against waste.

1. The Federated American Engineering Societies, organized in November, 1920, "for the sole purpose of public service."—In his inaugural address the president (Mr. Hoover) outlined the services which the Federation should render, laying his chief stress on the fact "that there is a great area of common interest between the employer and the employee through the reduction of the great waste of voluntary and involuntary unemployment and in the increase of production." To promote this common interest the Federation appointed a Committee on Elimination of Waste in Industry, consisting of 17 experts. Under the direction

of that committee some 50 engineers made a rapid analysis of waste in 6 typical branches of industry and published their unanimous report in October, 1921, under the title, *Waste in Industry.* The demand for this report has been so great that the book is already in its second printing. This work was but a reconnaissance of a limited field, but it produced definite improvement in some of the industries covered, and the discussions which the published report started are exerting a strong influence upon other industries.

2. Department of Commerce.—A second series of efforts to reduce waste has been inaugurated by the Department of Commerce. These efforts aim at diminishing loss and increasing efficiency by providing business men with more and better data concerning the needs of markets, sources of supply, and methods of manufacture, shipping and marketing. "Commodity divisions" have been organized to keep our leading industries advised concerning foreign as well as domestic conditions. A monthly periodical has been established, the *Survey of Current Business*, to make readily available and readily intelligible the statistical data required to guide business policy. A Division of Simplified Commercial Practice has been established with an engineer in charge. Conferences are being held with representatives of various industries to devise methods of eliminating wasteful multiplicity of products and to promote standardization of specifications, processes, and patterns. These are but three samples of a long list of efforts having a common aim.

3. The President's Conference on Unemployment.—In August, 1921, President Harding announced his intention to call a conference to consider emergency measures for relieving the widespread unemployment caused by the depressed state of business and to make "in addition a broad study of the economic measures desirable—to give impulse to the recovery of business and commerce." When the conference met it found that the statistical data concerning the number of men out of work were scanty and dubious. Nevertheless, the conference was able to frame a series of measures to relieve the existing emergency, and to provide a central agency to coördinate the measures taken by municipal governments for relieving acute distress. Like the work of the Committee on Waste, the preliminary work of the Unemployment Conference was pushed to quick completion, and the results have been substantial. The prompt organization under centralized guidance of relief measures has helped to mitigate the sufferings and the waste that threaten the country during the cold months. Municipal bond sales for public works have broken all previous records. An improvement in the construction situation is appearing. Congress has authorized work on several large federal projects, and has under consideration measures to improve the statistics of unemployment and to use public works in future as a balance wheel to stabilize industry. Not less important is the sense of responsibility aroused among employers to prevent distress among their own forces, and the focussing of public opinion upon the problem of *prevention* rather than *cure.*

4. The Long-Range Program of the Conference.—After making its immediate recommendations and setting up machinery to coördinate emergency measures, the conference agreed upon the necessity for an "exhaustive investigation into the causes and remedies of periodic business depressions." One of the

first tasks of the Standing Committee was to find an agency by which the investigation could be made promptly and intelligently. It selected the National Bureau of Economic Research as best equipped for this particular task.

5. The National Bureau of Economic Research, chartered in 1920 to conduct quantitative investigations into subjects that affect public welfare, is controlled by 19 directors, chosen both for the diversity of their social points of view and for their common belief in basing policies upon accurate knowledge of facts. It has drawn its financial support so far mainly, though not exclusively, from grants made by the Commonwealth Fund and the Carnegie Corporation. Its research staff includes men who have long been students of the business cycle.

6. Agencies Which Will Coöperate.—The preceding review of the successive steps in the development of the anti-waste campaign show in part, but only in part, how numerous and how able are the various agencies whose help can be secured to effect the object of the present campaign. In addition to the Committee on Waste of the Federated American Engineering Societies, the staff of the Department of Commerce, the members of the Conference on Unemployment, and the personnel of the National Bureau of Economic Research, proposals for coöperation have been cordially responded to by experts connected with the Bureau of Railway Economics, the Russell Sage Foundation, the Harvard Committee on Economic Research, the New School for Social Research, and the Pennsylvania State Industrial Board. The extensive knowledge and wide experience of all of these organizations and individuals can be promptly focussed upon the problem. It is the promptness and definiteness of past achievements, the eagerness with which the public has reached out for authoritative information presented under the auspices of impartial bodies, and the prospect of future cooperation from these bodies which justify belief that a basis for wise practical action can be laid within so short a time as six months.

Edward Eyre Hunt

## PROCEEDINGS OF THE EIGHTY-THIRD ANNUAL MEETING OF THE AMERICAN STATISTICAL ASSOCIATION

Pittsburgh, Pa., December 27–29, 1921

### PROGRAM

Tuesday, December 27

10.00 A. M.—First Session

*Topic:* Agricultural Statistics

*Paper:* The Problems of a Census of Agriculture,
William L. Austin, Bureau of the Census, Washington, D. C.

*Discussion:*
E. A. Goldenweiser, Federal Reserve Board, Washington, D. C.
W. A. Hathaway, American Tel. & Tel. Co., New York City
Nat C. Murray, Department of Agriculture, Washington, D. C.

*Paper:* A Summary of the Results of the 1920 Census of Agriculture,
Leon E. Truesdell, Bureau of the Census, Washington, D. C.

*Discussion:*
John Lee Coulter, North Dakota Agricultural College, Fargo, N. D.
L. C. Gray, Department of Agriculture, Washington, D. C.
Jesse E. Pope, Statistician and Economist, Washington, D. C.

2.00 P. M.—Second Session

*Topic:* Population and Vital Statistics

*Paper:* Some Results of the 1920 Population Census,
Joseph A. Hill, Bureau of the Census, Washington, D. C.

*Paper:* The Methods Employed in the Construction of the United States Life Tables,
James W. Glover, University of Michigan

*Paper:* Specific Death Rates from Tuberculosis in the United States,
Edgar Sydenstricker, U. S. Public Health Service, Washington, D. C.

*Discussion:*
William Charles White, M. D., Pittsburgh, Pa.

*Paper:* The Long Time Cycles of Pandemic Influenza,
Otto R. Eichel, State Department of Health, Albany, N. Y.

8.00 P. M.—Third Session (Joint Meeting with the American Economic Association)

*Presidential Addresses:*
The Economist's Spiral, Jacob H. Hollander, Johns Hopkins University
Statistics in the Service of Economics, Carroll W. Doten, Massachusetts Institute of Technology

10.00 P. M.—Smoker

### Wednesday, December 28

10.00 A. M.—Fourth Session

*Topic:* Business Research

*Paper:* The Nature and Status of Business Research,
Leonard P. Ayres, Cleveland Trust Company, Cleveland, Ohio

*Discussion:*
Ernest S. Bradford, New York City
M. C. Rorty, American Tel. & Tel. Co., New York City
Melvin T. Copeland, Harvard University

*Paper:* Graphic Methods Applied to Business,
Arthur R. Burnet, New York City

*Discussion:*
Earl F. Evans, Graphic Service Expert, Pittsburgh, Pa.
Earle Clark, General Motors Corporation, Detroit, Mich.
S. L. Nicholson, Westinghouse Electric Co., Pittsburgh, Pa.

2.00 P. M.—Fifth Session (Joint Session with American Association for Labor Legislation)

*Topic:* Business Forecasting

*Paper:* Business Cycles and Their Forecast,
Warren M. Persons, Harvard University

*Discussion:*
Carl Snyder, Federal Reserve Bank of New York
Wesley C. Mitchell, New School for Social Research, New York City

*Paper:* Management and the Business Cycle,
Henry S. Dennison, Dennison Manufacturing Co., Framingham, Mass.

*Discussion:*
Leonard P. Ayres, The Cleveland Trust Co., Cleveland, Ohio
F. L. Lamson, Norwalk Tire and Rubber Co., Norwalk, Conn.

5.00 P. M —Business Session

Brief meeting for reports of officers and committees and their consideration

### Thursday, December 29

9.00 A. M.—Final Business Session

Election of officers. Discussion of future policies

10.00 A. M.—Sixth Session (Joint Session with American Economic Association and American Association for Labor Legislation)

*Topic:* Industrial Accidents

*Paper:* The Present Status of Workmen's Compensation in the United States,
E. H. Downey, Harrisburg, Pa.

*Discussion:*
Powers Hapgood, Bureau of Industrial Research, New York City
Carl Hookstadt, U. S. Bureau of Labor Statistics, Washington, D. C.

*Paper:* Statistics of Industrial Accidents,
C. H. Verrill, U. S. Employees Compensation Commission, Washington, D. C.

*Discussion:*
A. W. Whitney, National Workmen's Compensation Service Bureau, New York City
E. E. Watson, Consulting Actuary, Columbus, Ohio

2.00 P. M.—Seventh Session (Joint Session with American Economic Association)

*Topic:* The National Income

*Paper:* Pareto's Law,
Fred R. Macaulay, National Bureau of Economic Research, New York City

*Discussion:*
David Friday, Michigan Agricultural College
William F. Ogburn, Columbia University

*Paper:* The Corporate Surplus as an Element in the National Income, Oswald W. Knauth, National Bureau of Economic Research, New York City

*Discussion:*

G. P. Watkins, Federal Trade Commission, Washington, D. C.
Allyn A. Young, Harvard University

## MINUTES OF THE ANNUAL BUSINESS MEETING

President Carroll W. Doten called the meeting to order at 5 p. m., December 28, at the William Penn Hotel, Pittsburgh, Pa.

Reports were submitted as follows:

### REPORT OF THE SECRETARY FOR 1921

The following report is submitted with respect to the condition of the Association:

| | | | |
|---|---|---|---|
| Membership, December, 1920 | | | 988 |
| Additions during 1921: | | | |
| New members | 102 | | |
| Corporate members | 2 | | |
| Total | | 104 | |
| [1] Deductions during 1921 | | 146 | |
| Net loss during 1921 | | | 42 |
| Membership, December, 1921 | | | 946 |
| Besides members we have: | | | |
| Subscribers, mostly libraries | | 262 | |
| Domestic exchanges | | 24 | |
| Foreign exchanges | | 73 | |
| Total members, subscribers, and exchanges | | | 1,305 |

The death of the following members has been reported during the year: Holmes Beckwith, Luigi Bodio (Honorary), George W. Brackenridge, Thomas U. Coe, W. B. Cogswell, John E. Clark, Frederick S. Crum, N. Hanabusa (Honorary), Harry H. Pray, R. H. Snead, Walter E. Weyl.

Four numbers of the PUBLICATIONS have been issued during 1921, completing

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[1] Above deductions during 1921 are distributed as follows:

| | |
|---|---|
| Deaths reported during 1921 | 11 |
| Resignations during 1921: | |
| Members | 78 |
| Corporate members | 2 |
| Dropped because unable to locate | 18 |
| Dropped for non-payment of dues | 37 |
| | 146 |

Volume XVII, a total of 1,050 pages for the two years 1920–21. The editor has prepared a comprehensive index to the entire volume, which is being issued with the December number.

Four special meetings of the Association have been held in New York City during the year, with an average attendance of over 100 members and guests. A fifth meeting was held in Washington, with an attendance of 45.

Respectfully submitted,

Robert E. Chaddock, *Secretary*

## REPORT OF THE TREASURER FOR 1921

### *Receipts*

| | | | |
|---|---|---|---|
| Membership dues | | $4,521.48 | |
| Sales, single copies of the Quarterly | | 156.29 | |
| Sales, Memorial Volume: | | | |
| Sales direct to members | $220.50 | | |
| Sales through the Macmillan Company | 87.98 | | |
| Total | | 308.48 | |
| Subscriptions to the Quarterly | | 1,077.79 | |
| Dividends on B. & A. Stock | | 148.75 | |
| Balance on hand at first of year | | 223.56 | |
| | | | $6,436.35 |

### *Expenditures*

| | | | |
|---|---|---|---|
| Printing: | | | |
| Printing Quarterly Publications: | | | |
| Balance due for September, 1920 | $500.00 | | |
| December, 1920 | 1,063.95 | | |
| March, 1921 | 1,013.04 | | |
| June, 1921 | 992.49 | | |
| September, 1921 | 398.19 | | |
| ($500 still due on Sept. issue) | | | |
| Authors' Reprints for June and Sept. issues | 85.97 | | |
| Total | $4,053.64 | | |
| Other printing, stationery, etc. | 362.69 | | |
| Total printing | | $4,416.33 | |
| Postage | | 208.21 | |
| Salaries | | 1,025.35 | |
| Payments on Memorial Volume Loan of $800 | | 400.00 | |
| Interest on Memorial Volume Loan | | 33.60 | |
| Expenses, miscellaneous | | 199.19 | |
| Balance on hand December 20, 1921 | | 153.67 | |
| | | | $6,436.35 |

### REPORT ON MEMORIAL VOLUME FUND 1921

*Receipts*

| | | |
|---|---|---|
| Sales to members at special rate ($3.50) | $220.50 | |
| Sales through the Macmillan Company | 87.98 | |
| Deficit for 1920 and 1921, paid out of general funds | 480.19 | |
| | | $788.67 |

*Expenditures*

| | | |
|---|---|---|
| Deficit for year 1920 | $338.89 | |
| Express | 4.68 | |
| Printing circulars | 11.50 | |
| Payments on $800 loan | 400.00 | |
| Interest on loan | 33.60 | |
| | | $788.67 |

*Payable*

The Association has a $400 loan on account of the Memorial Volume still outstanding at the Corn Exchange Bank, New York City. It owes the Rumford Press $500 for printing, due on the September issue.

*Assets*

Seventeen shares of Boston and Albany R. R. stock. Unsold copies of the Memorial Volume, approximately 440.

ROBERT E. CHADDOCK, *Treasurer*

### REPORT OF THE AUDITING COMMITTEE

We have audited the accounts of the treasurer of the American Statistical Association as of the close of business December 17, 1921, and find all disbursements properly accounted for by cancelled checks and vouchers. We have also verified the treasurer's record of receipts and disbursements, as shown by his books, with the cash balance on hand, as shown by the bank statement, and find them in agreement.

As is customary, we have made no audit of accounts payable and receivable.

DONALD R. BELCHER,
B. F. YOUNG,
*Auditing Committee*

The reports of the secretary-treasurer and the auditors were approved and ordered printed in the proceedings.

### REPORT OF THE EDITOR OF THE QUARTERLY PUBLICATIONS

The editor reported that the December issue of the QUARTERLY PUBLICATIONS marked the completion of Volume XVII, covering two years under the direction of the present editorial board. During this time 106 articles and featured notes were submitted for publication, 76 of which were published. The volume contains 49 articles, 27 featured notes, 32 short notes, and 56 reviews, comprising 1,050 pages and representing 107 different contributors. A single issue, therefore, contained approximately 6 articles, 3 featured notes, 4 short notes, and 7 reviews, making 130 pages. The new policy of having a section on featured notes, of including more miscellaneous notes, of developing the reviews, and of publishing a list of contemporary literature seems to have met with general approval. The custom of furnishing 50 reprints to authors of articles and featured notes has also been instituted.

During 1921 bids for publishing the QUARTERLY PUBLICATIONS were sought from various publishers. The Rumford Press, the present publishers, also made a new bid. All bids were submitted to the Board (consisting of president, vice-presidents, and counsellors), which voted to continue publishing with the Rumford Press.

The editor also reported the vote cast on changing the name of the QUARTERLY PUBLICATIONS.

### CHANGE OF NAME OF THE PUBLICATIONS

The report of the editor was approved, and on motion, duly seconded, it was voted to change the name of the QUARTERLY PUBLICATIONS to read "Journal of the American Statistical Association," beginning with the issue of March, 1922, the serial and volume numbering to remain continuous.

## REPORTS OF COMMITTEES

### THE JOINT ADVISORY COMMITTEE ON THE CENSUS

The report of the Joint Advisory Committee appears on pp 82–98 of this issue. It was approved, and the committee was continued for another year. The representatives of the Statistical Association on the Joint Committee were requested to submit at the next Annual Meeting a plan for a permanent organization of this committee.

### COMMITTEE ON FELLOWS

Carroll W. Doten, Chairman, reported for record the agreement of the committee in electing the following members as Fellows of the Association, as provided in Article V of the Constitution: C. J. Bullock, M. T. Copeland, C. B. Davenport, E. E. Day, E. F. Gay, E. A. Goldenweiser, J. H. Gray, L. H. Haney, L. N. Robinson, Elihu Root, M. C. Rorty.

### JOINT COMMITTEE ON STANDARDS FOR GRAPHICS

The representative of the American Statistical Association on this committee, Arthur R. Burnet, made the following report:

The growth of the arts, industry, and business has developed a need for the better presentation of information—numerical facts and other data—by means of charts and diagrams. Up to the present time this need has been met rather indifferently by the individual efforts of persons engaged in the arts, industry, and business without a comprehensive knowledge of good methods. The result has been the use of many defective graphic forms which have rendered ineffective a great deal of valuable data. This condition warrants the making of a consistent and thorough study of the entire subject of graphic presentation of facts in order to determine how far it is possible to establish standardized methods. The Joint Committee on Standards for Graphics has been organized to make such a study and to submit recommendations.

The committee, which is composed of representatives from the American Society of Mechanical Engineers, the Taylor Society, the Society of Industrial Engineers, and the American Statistical Association, does not represent all the groups interested in the subject; it is intended only to act as a clearing house or a means of accumulating from every source information bearing on the subject.

An invitation is therefore extended to all societies, associations, organizations, business concerns, and individuals to submit constructive comments and actual examples to the secretary. In due course it is hoped from this material to filter out the fundamentals, and to draft a code that will be simple, comprehensive, and so universal in character that statisticians, engineers, executives, accountants, teachers, and others may employ a common understandable language when speaking through the medium of graphics.

The committee realizes that the difficulties involved are great, but it hopes that the collective experience of the members together with the full coöperation of all interested persons *will enable this result to be accomplished.*

J. J. Swann, *Chairman,*
Representing the American Society of Mechanical Engineers
Carl G. Barth,
Representing the Taylor Society
C. E. Knoeppel,
Representing the Society of Industrial Engineers
A. R. Burnet, *Secretary,*
Representing the American Statistical Association

Address of the secretary: 11 Jackson Street, New Rochelle, New York

### COMMITTEE ON INSTITUTIONAL STATISTICS

The chairman, Horatio M. Pollock, statistician of the State Hospital Commission of New York, presented the following report:

Two meetings of the committee were held in New York City, one an all-day session on April 21, the other a half-day session on October 19. Four members of the committee were present at each meeting.

As committees of other organizations have been working for some time on the standardization of statistics in institutions for the insane, feeble-minded, and delinquents, this committee deemed it best to devote its attention to the problem of uniform statistics in institutions for dependent children. The need of standardization in this field is very great, as each state is now acting independently in compiling data concerning children in institutions, and in most cases the work is done inadequately.

After canvassing the situation and finding no satisfactory system in operation for collecting data in this field, the committee decided to undertake the preparation of a general statistical scheme for these institutions. Schedule cards for first admissions, readmissions, discharges, and deaths were prepared, and sub-committees were appointed to outline a standard set of tabular forms, to prepare a booklet of instructions, and to devise ways and means of introducing the new system. The work of these sub-committees is not yet complete.

The following notes on the introduction of the standardized system have been submitted by the sub-committee last named:

The most feasible method appears to be to work in each state through a central official state board, such as the State Board of Charities in New York state. These agencies in many cases have more or less definite jurisdiction over certain of the children's institutions. In these institutions the standard record forms could be introduced, and their adoption could be recommended in any other institution with which the state organization was in touch.

For the effective introduction of such a system in the several states, it would doubtless be necessary to have some general agency interested in furthering the adoption of the system. For such agency four bodies might be considered: The Federal Children's Bureau or the Bureau of the Census, among the official federal agencies, and among private agencies, the Committee on Statistics of the Children's Section of the National Conference of Social Work, or the present Committee on Institutional Statistics of the American Statistical Association. The field seems to be one in which the Children's Bureau is especially interested. The work is urgently needed, and the function of standardizing records might properly fall to that bureau which is especially charged with studying and reporting on dependent and delinquent children. From the point of view of the Children's Bureau, if it were to attempt to introduce a system of standard statistical records, the first step would seem to be the calling together of a conference to which representatives of state boards and other agencies especially interested in statistics of children would be invited, including the Committee on Institutional Statistics for Children and the Sub-committee on Statistics of the Children's Section of the National Conference for Social Work. The scope of the conference need not be limited to the subject of statistical records; addresses on the subject of standardizing statistical records would be especially appropriate. A special committee could be appointed to consider the question of statistical forms, and the recommendations of the Committee on Institutional Statistics for Children could be laid before it, together with recommendations from other committees, if they desired to make them. It would seem desirable to have ready for the consideration of such a conference not only standard forms for children in orphanages but also for other fields of work for dependent and delinquent children.

With regard to approaching the other agencies suggested on the subject of introducing a system of records in children's institutions, it seems advisable to wait until the committee could lay before them its final recommendations.

If the committee is continued another year it will be able to present to the Association at the next Annual Meeting a fairly complete outline of a system of statistics for institutions for dependent children, and will have definite advice concerning the means that may be taken to introduce the system in case it meets with the approval of the Association.

The report was approved and the committee was continued for the coming year.

### COMMITTEE ON NOMINATIONS

The report of the Nominating Committee, consisting of Walter F. Willcox, Chairman, L. F. Hayford, and C. E. Baldwin, was presented for final action. The secretary was instructed to cast one ballot for the nominations as presented. The following officers for the year 1922 were declared elected: President, W. S. Rossiter; Vice-Presidents, L. I. Dublin, E. W. Kemmerer, M. C. Rorty; Counsellors, C. W. Doten, W. C. Mitchell, W. F. Willcox; Secretary-Treasurer, R. E. Chaddock; Librarian, H. L. Wheeler; Editor, W. F. Ogburn.

The Board of the Statistical Association, in September, 1920, appointed George H. Van Buren as delegate to the third decennial session of the International Commission for the Revision of the International Classification of Causes of Sickness and Death, held at Paris, October 11–15, 1920. Mr. Van Buren presented his final report of the work done at the sessions of this commission. On motion of C. E. Baldwin, the report was received and filed.

The Association voted to appropriate $600, as provided last year, for assistance for the secretary-treasurer.

A resolution was offered and approved expressing the attitude of the Association toward the possible suspension of the publication of the *Market Reporter* by the Department of Agriculture and the *Monthly Labor Review* by the Department of Labor as follows:

*Resolved*, that the President be requested to convey to the proper authorities the unanimous request of the American Statistical Association, expressed at its Annual Meeting, that the publication of the *Market Reporter*, or a periodical containing similar material, and of the *Monthly Labor Review* be continued.

*Resolved*, that the Association express its sense of irreparable loss if these publications be discontinued in such important fields of statistical record and analysis.

Mr. R. D. Cahn, connected with the State Department of Labor of Illinois, urged the Association to provide a Committee on the Measurement of Employment. He called attention to the incomparable character of the published results and to the duplication of effort on the part of those agencies which seek employment data for various purposes in his state. Record forms for the collection of such data which would prove acceptable to various agencies, the methods of procedure in gathering and checking the data, and the methods of analysis and presentation of the results need to be thoroughly reviewed by a committee of a scientific association.

By a vote of the Association the Board of Directors was instructed to consider the situation and to provide a committee to deal with the matter.

Robert E. Chaddock, *Secretary*

## MISCELLANEOUS NOTES

**A New Name—The Journal of the American Statistical Association.** At the Eighty-third Annual Meeting of the American Statistical Association it was voted to change the name of our journal from the Quarterly Publication of the American Statistical Association to the Journal of the American

Statistical Association. For some time past suggestions have been made that the name be changed, the reasons being that the old name was long, and therefore cumbersome for bibliographic purposes. The name appeared still more awkward and less a name when because of a post-office regulation the word "Publications" was changed to "Publication." The matter was brought up at the Eighty-second Annual Meeting and it was then voted to ask the opinion of the membership of the Association. The 302 replies received were distributed in the following manner:

| | |
|---|---|
| For the Quarterly Publication of the American Statistical Association | 29 |
| the Journal of the American Statistical Association | 107 |
| the American Statistical Quarterly | 54 |
| the American Statistical Review | 86 |
| the Statistical Association Quarterly | 12 |
| other names | 14 |
| | 302 |

At the business meeting of the Association, after some discussion of the relative merits of the proposals, the name was voted changed.

**Advertising to be Accepted in the Journal.** Replies to an inquiry sent in 1921 to each member of the American Statistical Association showed a strong approval of the proposed policy of accepting advertising in our Journal, and very few objections. The Board of Directors of the Association has, therefore, authorized a very limited amount of advertising of such character as is considered appropriate and dignified for our publication. Members and others wishing to insert business cards should communicate with the secretary of the Association. The special attention of manufacturers and distributors of tabulating, computing, and graphic devices is called to this opportunity to reach those who recommend statistical equipment. For the present the rate will be twenty-five dollars a page for a single issue. Rates for less space may be obtained from the secretary.

**The Census Report of Ceylon.** This is a most interesting and concise presentation of the essential facts of the Census of Ceylon for the year 1921, published with admirable promptness by the Superintendent of the Census and Director of Statistics, L. J. B. Turner, M.A., C.C.S. The report includes a graduated population table based on the assumption that "the observed population is understated by at least 1/10000." The probable error is, however, of only slight importance; for while the enumerated census population corrected to March 10 was 4,500,000, the graduated population was 4,568,000. The table includes a forecast of the population for 1931, placed at 5,194,000. The Report includes a table of births and deaths and a table of the arrival and departure of estate coolies since 1900, the coolies constituting the major portion of the migratory element of the Ceylon population. The wide fluctuations in migration clearly influence population estimates upon purely theoretical assumptions.

The report includes also a considerable amount of economic data, such as Revenue and Expenditure, Total Trade of Imports and Exports, mostly for the preceding decade. In Ceylon, as it has been observed elsewhere, imports during 1920 increased considerably, while exports declined. The highest figure for exports since 1870 was reached in 1919. The three chief elements of export are rubber, tea, and cocoanut products. Rubber production during 1920 declined, but not so much as has generally been assumed to be the case on account of the depressed condition of the rubber trade. Tea exports declined to the lowest figure since 1909. Cocoanut products fairly held their own, although they reached a lower figure than during the preceding year. It is of interest to note that 44.5 per cent of the rubber of Ceylon was exported to the United States in 1920, against 65.8 per cent in 1919 and 37.2 per cent in 1918. In contrast, of the exports of black tea only 7.9 per cent reached the United States in 1920, while 65.9 per cent was exported to the United Kingdom.

Regardless of the depressed condition of foreign trade, Post Office Savings Bank deposits reached the highest figure since 1912. The corresponding social condition of the people is indicated by the fact that the number of homicides in 1920 was less than in 1908, while the convictions for burglary were only slightly in excess of the earlier figures. Of interest is the statement that the number of motor vehicles in Ceylon increased from 745 in 1911 to 4,805 in 1920.

Finally, there is included a suggested table of monthly temperatures for eight selected stations, showing variations as chiefly influenced by altitude from an average temperature of 80.7 for Colombo to 59.2 for Nuwara Eliya. The former point is practically at sea level, while the latter is at an elevation of 6,188 feet.

The report is an admirable contribution to statistical year books, presenting concisely and by means of diagrams the essential social and economic facts of this important dependency of the British Empire.

F. L. Hoffman

**A New Outline of Statistics.** Professor Franz Zizek of the University of Frankfurt has just published, through Duncker and Humblot of Munich, an outline of statistics, *Grundriss der Statistik*, a work of about 470 pages, in which he surveys the entire field of statistics, theoretical and practical. His object is to furnish students of economics with a simple and brief guide to the methods and main results of statistics, and to the statistical aspects of those divisions of social science which have been investigated. Accordingly it emphasizes the field of economic statistics, production, commerce and trade, incomes, consumption, labor, wages, etc. The writer is known to the American public mainly through his book, *Statistical Averages*, which appeared in a German edition in 1908, and five years later in an English translation made by Professor W. M. Persons and issued by Henry Holt and Company.

**Monthly Reports of Vital Statistics for Canada.** The Dominion Bureau of Statistics of Canada has begun to issue monthly reports of vital statistics giving data for eight provinces. As the result of conferences held during 1919, a plan of coöperation in the collection, compilation, and publication of the statistics of births, marriages, and deaths was arrived at between the Dominion Bureau of Statistics and the Registrar General's Departments in all the Canadian provinces except Quebec and Yukon. The Bureau undertook to print and supply forms for the provinces, and the provinces agreed to collect and visé the returns, and to forward either the originals or certified transcripts of them for compilation and publication for the Dominion as a whole. In this way a registration area for Canada has in fact been constituted. A summary for 1920 has been compiled. To date, five monthly reports have appeared, showing in detail for each province comparative figures for 1920 and 1921 for births, marriages, and deaths by cause; infantile and maternal mortality; and births, marriages, and deaths in cities and towns.

**Reports on Earnings and Employment.** The Statistics Department of the Federal Reserve Bank of New York has recently issued two reports containing tables and diagrams showing the course of average weekly earnings and of the number of workers employed in fourteen different industries in New York state and in the United States. These figures are the data back of the aggregate figures published from time to time in the *Monthly Review of Credit and Business Conditions.*

**Proposed Revision of Index Numbers of Wholesale Prices.** The index numbers of wholesale prices published by the United States Bureau of Labor Statistics are being reweighted. The revised numbers will be announced soon. The new weights will be based on the census of 1919, the old weights being of the date 1909. Besides the substitution of new commodity weights in place of those previously used, a slight rearrangement of the commodities into groups is planned. By the new method a commodity which properly belongs in more than one group will be so treated, care being taken, however, to include it only once in the general index. For example, structural steel, nails, and iron pipe, which hitherto have appeared only in the group of metals and metal products, will in future appear also in the group of building materials, but will be counted only once in the general index. In like manner wheat, corn, and rye will appear as raw materials in the food group, as well as in the group of farm products, while cotton and wool will be treated as textile materials in the clothing group in addition to their inclusion with farm products. Besides these changes, a careful survey is being made to determine what articles should be included in the several groups in addition to those already carried.

**A New Philippine Health Service Bulletin.** The *Quarterly Report of the Philippine Health Service* has been discontinued and a *Monthly Bulletin* is being issued instead. In addition to vital statistics for the month the new publication contains articles pertaining to public health. In the first number (July, 1921) appeared a report of the Committee on Anti-Cholera Vaccination and a paper on the ravages of venereal diseases.

**Revision of Newsholme's "Vital Statistics."** Students of vital statistics will be interested to learn that Sir Arthur Newsholme, who has returned to England, is now engaged in a revision of his classic textbook, *Vital Statistics*. Dr. Newsholme will be glad to receive notes and suggestions for the improvement of his book from those who have used it in class work or in their own studies. He should be addressed at Ashley House, Shalford, Surrey, England.

**Record Keeping in Public Health Nursing.** Five lectures on Record Keeping in Public Health Nursing by Dr. Louis I. Dublin, which were delivered during 1921 and which appeared in the *Public Health Nurse*, have been combined as one reprint and can be obtained by writing to the Statistical Bureau of the Metropolitan Life Insurance Company.

**New Committee on the Atmosphere and Man.** The National Research Council has appointed a Committee on the Atmosphere and Man. Among the sub-committees there is one which is considering the possibilities of a statistical investigation of the relationship between climatic factors and the death rate. This sub-committee consists of the following members: Ellsworth Huntington, Yale University, Chairman; Louis I. Dublin, Metropolitan Life Insurance Company; J. Arthur Harris, Station for Experimental Evolution; Frederick L. Hoffman, Prudential Life Insurance Company; Arthur Hunter, New York Life Insurance Company; G. T. Palmer, Board of Health, Detroit; and Raymond Pearl, Johns Hopkins University.

**Educational and Professional Standards for Statisticians.** The Board of the American Statistical Association has appointed a Committee on Educational and Professional Standards for Statisticians. The committee, of which Malcolm C. Rorty is chairman, will attempt to formulate, during the year, tentative standards for the purpose of stimulating discussion. A similar committee, of which Edwin W. Kopf is chairman, was appointed later by the Section on Vital Statistics of the American Public Health Association to coöperate with the Statistical Association in this work.

Mr. Milan V. Ayres, formerly statistician with the Interstate Commerce Commission and more recently with the Statistics Branch of the United States Army, is now statistician of the Associated General Contractors of America and editor of the *Index*, the statistical organ of that Association. This publication presents an analytic and graphic review of statistics relating to the construction industry. It is issued weekly from the office of the Association at 1038 Munsey Building, Washington, D. C.

Mr. B. R. Buckingham has left the University of Illinois to become director of the Bureau of Educational Research at the Ohio State University.

Mr. Earle Clark has resigned as chief statistician of the General Motors Corporation to become treasurer of the J. Walter Thompson Company, 244 Madison Avenue, New York City.

## NEW MEMBERS ELECTED SINCE 1921

Abbot, Louis A., Bureau of Statistics, Interstate Commerce Commission, Washington, D. C.

Bloor, W. F., Statistician, Goodyear Tire & Rubber Co., Akron, Ohio

Boddington, A Lester, H. Foulks, Lynch & Co., London, England; Fellow, Royal Statistical Society

Cahn, Reuben D., Statistician, Illinois Dept. of Labor; lecturer on Economics, Northwestern University, Evanston, Ill.

Cope, Gertrude V., Statistician, Sales Research Division, Phoenix Mutual Life Ins. Co., Hartford, Conn.

Du Bois, Florence, Bureau of Education, Washington, D. C.

Franzen, Raymond, Director of Research, School Board Office, Des Moines, Iowa

Folsom, M. B., Asst. to President, Eastman Kodak Co., Rochester, N. Y.

Glueck, Charles F., Life Insurance Statistics, Boston, Mass.

Grantham, James, Committee on Conservation and Advance, Methodist Episcopal Church, Chicago, Ill.

Grassmuck, Chester P., Tide Water Oil Co., 11 Broadway, New York City

Grove, Charles C., Mathematical Research, Metropolitan Life Ins. Co., New York City

Henderson, L. G., Ronald Press Co., 20 Vesey St., New York City

Hettinger, A. J., Consulting Statistician, Federal Reserve Bank of Boston; instructor in Business Statistics, Harvard University

Horning, F. J., Dominion Bureau of Statistics, Ottawa, Canada

Huntington, Mrs. Susie Van V., Bureau of Business Research, Graduate School of Business Administration, Harvard University, Cambridge, Mass.

Jordan, Edwin O., Professor of Bacteriology, University of Chicago, Chicago, Ill.

Kahn, Walter B., Lazard Frères Co., 19 Nassau St., New York City

King, Estella C., N. Y. City Employees Retirement System, Municipal Bldg., New York City

Lies, B. Eugenia, Director of Planning, R. H. Macy & Co., New York City

Marshall, Herbert, Dominion Bureau of Statistics, Ottawa, Canada

Pitlik, Samuel, Research, Vital Statistics, John Hopkins University, Baltimore, Md.

Ramsperger, H. G., Export and Import, 116 Broad St., New York City

Raver, Carl F., Director, Division Vital Statistics, State Health Dept., Charleston, W. Va.

Richter, Frederic E., Statistician, American Tel. & Tel. Co., New York City

Smith, Mark A., U. S. Tariff Commission, Washington, D. C.

Vesely, Joseph E., Chief Statistician, W. A. Wieboldt & Co. Department Stores, Milwaukee, Wis.

Wolfe, A. B., Professor of Economics and Sociology, University of Texas, Austin, Texas

# REVIEWS

*Tariffs: A Study in Method.* By T. E. G. Gregory. London: Charles Griffen & Co., Ltd. 1921. xiii, 518 pp.

This book, by the Cassel Reader in Commerce in the University of London, is a comprehensive, thorough, and on the whole scholarly study of tariff technology, without a serious rival in its field in the English language, and probably not in any language. There does not suggest itself to the reviewer a single phase of the field of tariff technology which this book does not more or less adequately treat, with the possible exception that there is no discussion of smuggling. Obviously the product of considerable and laborious research, this work is valuable not only for its analyses and classifications of governmental methods of constructing and of administering the tariff laws, but also for the wealth of raw material which is presented for illustrative purposes. The author deliberately refrains from discussing the political phases of the tariff question involved in the free-trade-protection controversy. But on narrower questions, such as the effectiveness of tariff retaliation and of reciprocity, and the comparative merits of the conditional and unconditional forms of the most-favored-nation clause in commercial treaties, he does not confine himself to description and classification, but reasons effectively and convincingly in support of his own conclusions.

This due measure of praise having been accorded the book, it remains to be said that it is not innocent of faults, both of omission and of commission. In so far as the reviewer can judge, the author has made very extensive and thorough use of British, German, and French literature on the subject, but, as is too often the case with British writers, he has not made as abundant use of readily available American material as its merits would justify. In several instances, to which specific reference will be made subsequently, more extensive inquiry into what Americans have written in the field covered by this book would have prevented the author from falling into error, or would have enabled him to give a more thorough and satisfactory presentation.

Mr. Gregory pays a generous tribute to the work of the United States Tariff Commission in the field of tariff research. "The work of the commission in the period of time that it has existed is already such, both in volume and in quality, as to indicate that it is likely in the future to become the most important source of detailed and critical tariff literature to which the student of tariff matters can turn" (p. 60). Unfortunately he has not taken as full advantage of the literature published by the Commission as was feasible. With the one exception of its *Report on Reciprocity and Commercial Treaties*, to which he makes extended reference, he has relied apparently on the summaries given in the *British Board of Trade Journal* for knowledge of the contents of the Commission's reports. In one case his reliance on second-hand summaries leads him unjustly to charge the report of the Tariff Commission on "Free Zones" with confusion between what the Tariff Commission distinguishes as "Free Ports" and "Free Zones"

(p. 371). His discussion of anti-dumping legislation would have profited from the utilization of the Tariff Commission's 1919 report on this subject. His treatment of colonial tariff policies—by far the weakest portion of his book—and of commercial treaties shows by its inadequacy the need of such studies on these two topics as the Tariff Commission has just published or is in process of publishing. Again, his references to American methods of customs administration would have gained in value if he had not relied on an outside summary of the Tariff Commission's 1918 report on this subject.

The book is open also to another general criticism. Too much space is given to fine-spun classification, carried to such an extreme for some of his classes that the author does not, and presumably cannot, cite a single illustrative instance. Where the variety of possible situations is almost unlimited in its range, and where new forms can easily be devised to meet new situations, there is little to be gained from an attempt at an exhaustive listing of the existent or possible forms.

On a number of minor points of detail the author either is in error in his citation of facts or is ambiguous, or gives an erroneous interpretation in consequence of an inadequate survey of the situation. The author has done yeoman spade work, and these defects in details are not important enough either individually or in the aggregate to detract seriously from the merits of the book as a whole. It will be well to point them out, however, for the authoritative position which this book will unquestionably be given in its field may otherwise give further currency to erroneous or questionable information.

France, according to Mr. Gregory, is the country which is the most wedded to the policy of tariff assimilation with its colonies (p. 9). This characterization could be applied with more accuracy to Japan, which has assimilated the tariffs of *all* its colonies—not including, however, the leased territories, which are not properly to be classed as colonies—to its own tariff. It may even be argued that the United States with its assimilation of the tariffs of Alaska, Hawaii, and Porto Rico, and its trend toward similar tariff assimilation in the other colonies where treaty obstacles are not in the way, is more attached to this policy than France. Not only is a larger numerical percentage of the American than of the French colonies under the tariff régime operative in the mother country, but in France the policy of assimilation is very much on the defensive, whereas in the United States it is not subjected to serious opposition from any quarter.

Canada is rightly cited in support of the claim that political unity generally precedes or accompanies tariff unity (p. 16). Tariff unity of continental British North America waited upon the establishment of political unity in 1867 and subsequent years. But tariff union preceded by many years the establishment in 1841 of political union between Upper and Lower Canada.

Division of the customs revenues of a customs union among the members thereof according to population is cited as the obvious method of division, and no other methods are specifically enumerated (p. 17). As illustrations of other methods of division may be cited (1) the case of Upper and Lower Canada prior to 1841, when division was according to agreed upon percentages having no definite relation to population, and (2) the case of the South African Customs

Union, where division has been partly according to relative dutiable imports of the constituent parts from outside the Union, and partly according to customs receipts of the constituent parts prior to Customs Union.

Congress is not limited to voting on tariff bills by schedules to the exclusion of voting by individual rates, as is indicated in the text (p. 50).

Mr. Gregory's reasoning that revenue import duties are likely to operate in their incidence according to the principle of minimum sacrifice (*i. e.*, progressively?) if they consist of heavy rates on a few commodities, and according to the principle of equal sacrifice (*i. e.*, proportionately?) if they are moderate duties spread over a large number of commodities, if it is here correctly interpreted, will not withstand analysis. If the few articles taxed are commodities of general consumption, the duties are as likely to be proportional in their incidence as if many articles are taxed. Concentration of taxation on relatively few commodities of general consumption does not work out in it its incidence in the same way as concentration of taxation on the relatively few great incomes. Heavy import duties on a few commodities of general consumption may even be regressive in their incidence, if the duties are specific instead of ad valorem, or if the total expenditures of rich and poor on the taxed commodities are not greatly dissimilar, or if the total expenditures on such commodities constitute a much larger percentage of the total income of the poor than of the rich. The author subsequently resumes his discussion of the incidence of revenue import duties (pp. 490–1, 498) with results flatly contradictory to those first presented, and more in harmony with the reasoning presented above.

The author generalizes too broadly when he states that the protective tariff includes a larger number of dutiable articles than the revenue tariff (p. 68). This would be an obvious but misleading inference from a comparison, for example, of the short pre-war free-trade tariff of Great Britain with the lengthy tariffs of the major protectionist countries. Most of the free-trade colonies make a great number of imported commodities dutiable. The free lists of Egypt, China, and India, all of which are free-trade countries, are much shorter than the free lists of the United States and Canada, which follow protectionist tariff policies. The statement that "the normal rate per commodity in the revenue tariff is a single rate; in the others a multiple rate" (p. 68), if by it is meant that rates with revenue intent are normally single, whereas rates with protective intent are normally multiple, has a very limited measure of validity. Practically all the Latin-American countries have single-schedule protective tariffs. Great Britain has multiple-rate revenue duties in the preferential schedule of her tariff, as have a number of the British dominions and colonies. The United States tariff is at the same time primarily a single-schedule tariff and a protective tariff. In the history of American tariff-bargaining with other countries, it has generally been the case that special concessions from the general rates of duty were granted with less hesitation in the case of revenue duties than in the case of protective duties. The only instance known to the reviewer where a country has withheld the application of a general multiple-rate tariff policy from such of its duties as were intended primarily to produce revenue is in the case of Canada. In the Canadian tariff the rates on tobacco and on alcoholic liquors, but not the rates on sugar, are single rates, whereas on almost all other dutiable imports there are multiple rates.

The statement that the Canadian tariff is to some extent a four-schedule tariff, since there is in addition to the three statutory schedules a conventional schedule comprising the "group of rates *lower* than the intermediate tariff rates" which had been granted by treaty to France and subsequently extended to all countries entitled to most-favored-nation treatment (pp. 71–2) is misleading in several particulars. The intermediate schedule, since it is merely a statement in the tariff act of the maximum range of concessions from the general rates which may be granted to foreign countries in exchange for reciprocal concessions without further legislative authorization from Parliament, is not actually in effect except as merged in the conventional schedule. The conventional schedule includes all the concessions from the general rates actually conceded to foreign countries. It originates in rates granted by treaty to Italy as well as to France. Its rates are sometimes identical with the rates of the intermediate schedule, sometimes lower.

The experience of France, Germany, the United States, and Canada in differentiating in their tariff treatment between imports from first-class commercial countries does not bear out the statement of the author that "the multiple tariff if applied to a first-class commercial nation would offer very great difficulties in enforcement" (p. 85).

As comment upon the author's statement that at any rate between the leading commercial powers where there was differentiation in the treatment of imports from different countries, the withholding of the lower rates was the exception and their application the general rule (p. 172), it is to be noted that this may have been due chiefly to the general practice of unconditional most-favored-nation treatment. Countries which followed the conditional practice were likely to reverse the rule. The United States, Brazil, and Cuba may be cited as current illustrations of the application of the lower rates being the exception rather than the rule for countries which follow the conditional most-favored-nation practice.

In his survey of anti-dumping legislation (p. 174, *et. seq.*) the author overlooks the fact that the "undervaluation" section in the United States Tariff Act of 1913,[1] and perhaps in earlier acts, was actually a penalizing provision against dumping as well as against undervaluation proper. The penalty provided for in this section was directed not only against fraudulent entry at lower prices than those actually governing the importation, *i. e.*, undervaluation proper, but also against entry in good faith at prices lower than those generally prevalent in the country of export, *i. e.*, dumping. It is probable that when Congress in 1916 enacted an anti-dumping law it was unaware that it had already done so in 1913. Mr. Gregory confesses failure to find a satisfactory all-inclusive definition of dumping (p. 178). Against the definition given above, namely, selling in the foreign market at lower prices than in the home market, he objects that even the lower foreign price may be remunerative to the seller. The term "dumping" does not necessarily connote loss to the seller, and dumping should be carefully distinguished from sacrifice sales. Once the possibility of export dumping as a permanent operation is admitted, it follows that unremunerativeness is not a necessary concomitant of the process. The only defect of the definition suggested here is that it does not sufficiently guard against treating as dumping the proper and normal practice of quoting lower export than domestic prices when export sales are generally much greater in value per unit sale than are domestic sales, and also that it does not cover the case of an exporter of a commodity without a domestic market—*e. g.*, tropical worsteds in England—who quotes lower prices in one market than another in order either to eliminate a competitor in the market dumped-on, or to get rid of surplus stock in a market he is not especially exploiting in order not to "spoil" his important markets.

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[1] Section III, paragraph 1.

Mr. Gregory appears to be doubtful of the possibility of demonstrating that there was a protective intent to much of the legislation which has been enacted in the guise of sanitary regulations (p. 194). A cursory survey of the diplomatic negotiations carried on by the United States with Germany under the Harrison, McKinley, and Roosevelt administrations, and of the current discussions in official circles and in the press in Great Britain and Canada of the exsting British prohibition of the importation of Canadian live cattle, would iremove his doubts.

The objective of tariff item No. 644 in the United States Tariff Act of 1913 is misinterpreted when this item is cited in illustration of the class of offers "to sacrifice similar duties for similar duties" (p. 243). The tariff item in question imposes duties on "wheat flour, semolina, *and* other wheat products not specifically provided for in this section" only when imported from countries which impose duties "on wheat *or* wheat flour *or* semolina imported from the United States." It is really an instance of a class of reciprocity offers overlooked by Gregory, viz., the offer to sacrifice a duty on a specified commodity in return for the sacrifice of a duty on a specified *different* commodity. The object of the contingent duty was not so much to secure the reciprocal free admission (a) of wheat, (b) of wheat flour, and (c) of other wheat products, respectively, but rather to induce other countries, and Canada in particular, to remove their duties on American *flour* in return for the removal of the American duty on their wheat.

Gregory's restriction of Open Door Colonies to those "whose tariff régime is fixed by international agreement" (p. 251) unwarrantedly excludes from this class those colonies whose revenue and non-discriminatory tariffs were not fixed by international régime, namely, the colonies of Holland, the Danish West Indies prior to their purchase by the United States, some of the German colonies prior to their conquest by the Allies, and most of the British Crown Colonies.

The discussion of the colonial tariff system of the United States (p. 261, *et seq.*) is sketchy and inadequate. Guam (spelt Guan throughout) is wrongfully located in the Samoa group of islands. The Virgin Islands acquired from Denmark are not mentioned. Hawaii is included in the list of American colonies, but Alaska is not. The tariff treatment of imports into Guam, Tutuila, and the Canal Zone is not defined.

The grant of preferential, as distinguished from most-favored-nation, treatment by Canada to Great Britain dates from 1898, and not 1897, as stated by the author (p. 269).

There is no adequate ground for accepting Lord Ripon's despatch to the governors of the British self-governing colonies in 1895, in which are defined the principles which the colonies must follow in their tariff negotiations with foreign countries, as a binding definition of the scope of British colonial autonomy in tariff matters. Mr. Gregory is wrong when he gives the impression that it is, or ever was, accepted by the colonies as the last word on the subject (pp. 269, 270). As a matter of fact, Ripon's chief dictum, "Her Majesty's Government regard it as essential that any tariff concessions proper to be conceded by a Colony to a Foreign Power should be extended to this country and to the rest of Her Majesty's Dominions," was not enforced either against the reciprocal arrangement between Cape Colony and the Orange Free State which was in effect when Ripon's despatch was sent, or against the similar arrangement still in effect between the Transvaal and Mozambique.

The exemption from a fraction of the export duty on tin ore in the Federated Malay States which was granted in 1903 if the ore was exported to be smelted in the Straits Settlements, and extended in 1904 to ore exported to the United Kingdom (p. 288), was further extended in 1916 to ore exported for smelting to Australia. The origin of this differential treatment of a raw material is somewhat obscure. When first enacted it was an exception to the general rule, rigidly enforced by the British Imperial authorities, that the commercial policies of the dependent parts of the Empire should be managed in strict accord with the principle of the open door. In the post-war period this differential export duty has been cited as a precedent for a more extensive program of treatment along the same lines of the raw materials of the British crown colonies.

Finally, the prohibition of export duties was not incorporated in the American Constitution because "a certain prejudice attaches to export and transit duties which one does not find in the case of import duties" (p. 483). It was, of course, due rather to the fear of the Southern states that if export duties were levied they would be imposed chiefly on southern products, and especially on cotton and tobacco, and their refusal to concede to the federal government the authority to levy import duties—also likely to operate chiefly in the interests of the North Atlantic States—unless accompanied by a prohibition of export duties. It was a matter, therefore, not of prejudice, but of conflicting sectional interests adjusted by compromise. The individual Southern States had themselves made important use of export duties prior to 1789.

JACOB VINER

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*Essentials of Mental Measurement.* By William Brown and Godfrey H. Thomson. Cambridge Press, 1921. x, 216 pp.

This edition is so radical a revision of the first edition by Mr. Brown as in reality to constitute a new work. The best of the earlier work has been retained, and five entirely new chapters, the work of Mr. Thomson, have been added. These chapters are:

II. The Elementary Theory of Probability
IV. Skewness and Heterogeneity in Psychophysical Data
VII. The Influence of Selection
IX. The Theory of General Ability
X. A Sampling Theory of Ability

Part I is entitled "Psychophysics," and Part II, "Correlation." However, the book could properly be divided into three parts—psychophysics, correlation, and a criticism of theories of ability. The chapters upon psychophysics aim to give the elementary statistics required in the handling of psychophysical data, and though the rules and explanations given are excellent and more rigorous than are usually found in elementary treatises, it can hardly be said that the ground is adequately covered for the needs of the experimental psychologist who is unfamiliar with the basic concepts of frequency distributions. The more special problems of psychophysics are fully dealt with. The chapter upon correlation parallels the work of the first edition, and an important chapter upon the influence of selection is added. Here again the treatment is too brief to meet the ordinary needs of the psychologist.

In the opinion of the reviewer the most interesting contribution of the book lies in the thoroughness with which the authors have demolished Hart and Spearman's criterion for the existence of a hierarchical order among coefficients of correlation.

The book shows careful thought and workmanship throughout, and the following criticisms are inconsequential as far as the general appraisement is concerned. On page 16 the value of the lower quartile is given as that of the $N+\frac{1}{4}$ measure, whereas it should be that of the $N+\frac{1}{2}$ measure. This leads to error in the lower and upper quartiles and in the interquartile range. The treatment (beginning with page 60) of the important though admittedly difficult point concerning the effect of different proportions of equal judgments when less than, equal, or greater than judgments are recorded is inadequate.

The only unmitigatedly bad advice in the book concerns the use of "catch tests" and the treatment of erratic answers [component a]. The reviewer objects to the following statement which is quoted from page 93: "Use of 'catch' tests in threshold determinations is to check component (a). The proper way to employ them is to cancel sittings at which numerous catch errors occur, the subject being then presumably in an abnormal state."

At a number of points throughout the book there is the implication that correlation and other statistical constants calculated from a population of thirty or less is of very slight significance because probable errors are unknown. This caution is in the right direction, but it is far from accurate to imply that populations of thirty or somewhat less cannot yield valuable information if treated statistically and interpreted in the light of known probable errors of small quantities. From the standpoint of practical psychology we particularly need to know if tendencies suggested by small populations are worth further investigation.

The authors admit, or possibly we would better say, claim, differences of opinion between themselves and Professor Spearman, and in their enthusiastic endeavor to show errors in Spearman's work do not clearly differentiate between inconsequential and material errors in his mathematical processes. Every statistician at times makes assumptions of normality, rectilinearity, independence between variables, etc., which are not strictly true. It is not sufficient that the critic establish the fact that the assumption is inaccurate; he must go further and show that it leads to material error. Several of the Brown and Thomson criticisms of Spearman fail to establish the material nature of the error in the Spearman assumptions, *e. g.*, the error involved in using $r_{xy}$ in the formula for correction for attenuation in place of $\sqrt[4]{r_{x_1y_1}r_{x_1y_2}r_{x_2y_1}r_{x_2y_2}}$.

The "Sampling Theory of Ability" formulated by Thomson seems to the reviewer to be a concise statement of a point of view already held by many psychologists. It is a distinct addition, however, to have it so definitely stated as to suggest an experimental and mathematical testing and comparison with alternative theories.

On the whole, Brown and Thomson have made a contribution which is not only helpful in the detailed problems of psychological statistics but suggestive and forward-looking in the more subtle problems of mental acquisition. It will find a place in every psychological library and laboratory.

TRUMAN L. KELLEY

Stanford University

*Report of the Federal Trade Commission on the Pacific Coast Petroleum Industry. Part 1: Production, Ownership, and Profits.* Washington: Government Printing Office, April 7, 1921. 276 pp.

The investigation resulting in this report was authorized by a resolution of the Senate passed on July 31, 1919. The resolution was introduced by the Senator from Washington, and the occasion of the resolution was the "recent advance in the market price in the United States, especially on the Pacific coast, of fuel oil, kerosene, gasoline, and other petroleum products." The results of the investigation were transmitted to the Senate on April 7, 1921, and Part 1 of the report was made available to the public several months later,[1] fully two years after the inception of the investigation and at a time when the prices of petroleum products were slowing up from the most precipitous decline in the history of the industry.

The report is the result of a detailed study of the records of a large number of operating companies, supplemented by additional information gathered through questionnaires, and a thorough compilation of published statistics. The work of analysis is handled largely by means of accounting technique, with only incidental employment of supplementary methods of economic analysis. The data are studied mainly from the point of view of conditions within the petroleum industry; the bearing of fundamental economic factors such as the price level, the phase of the business cycle, the rate of earnings in other industries, and the flow of investment funds are not evaluated. In consequence, a great wealth of raw and refined statistics is assembled, many generalizations of current conditions are placed upon a quantitative basis, and the structure of the industry is measured in many respects; but the underlying reasons for the conditions analyzed, being beyond the authorized scope of the investigation, are not brought forth.

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[1] A brief summary of the report was published more promptly under the title, *Summary of Report of the Federal Trade Commission on the Pacific Coast Petroleum Industry. Part 1: Production, Ownership, and Profits.* The second part of the report (yet to appear) "will discuss the prices of crude petroleum, of fuel oil, and refined petroleum products in the principal markets on the Pacific coast, the methods of distribution and of marketing such products, and the conditions of competition in the entire Pacific coast territory."

Some of the main conclusions reached in Part 1 of the report may be summarized as follows:

1. All branches of the petroleum industry on the Pacific coast—production, refining, and marketing—are "dominated by a few large interests which control most of the proven lands and operate nearly all the pipe-line and refining equipment." For example, seven large interests on March 1, 1920, owned 68 per cent of the proven land of California and in 1919 produced 71.5 per cent of the total crude petroleum output of the state; while five companies were the only important factors in the fields of transportation, refining, and marketing.

2. The costs of producing crude petroleum vary widely among different fields and among different companies in the same field. The chief factor in cost is the volume of production per well. For all companies investigated the average cost of producing crude petroleum in California was 27.4 cents per barrel in 1914, and 46.3 cents per barrel in 1919. Costs vary inversely with the volume of production. In 1919 the companies producing over 1,000,000 barrels annually showed an average cost of 24.5 cents per barrel, while producers with a yearly output of 50,000 barrels and under supported an average cost of $1.21 per barrel.

3. The cost of refining crude petroleum in California, including the cost of crude, was $0.738 per barrel in 1916, and $1.259 a barrel for the first half of 1920. The principal element in the cost of a barrel of refined products is the raw material, crude petroleum, which represented 74 per cent of the total cost in 1919.

4. The average rate of earnings of the five large integrated companies operating in California was 8.3 per cent in 1914; 7.0 per cent in 1915; 14.4 per cent in 1916; 19.2 per cent in 1917; 26.0 per cent in 1918; and 23.6 per cent in 1919 (first half); or an average of 17.0 per cent over the entire period. The rates of earnings are somewhat greater than those shown in the companies' books, because of certain readjustments made by the Commission but not explained in full detail in the report.

5. An analysis of the petroleum industry of the whole country for the year 1919 indicates that the profits of the California petroleum industry were not exceptional as compared with other sections of the United States. Eighty-two producing companies in all parts of the country in 1919 enjoyed an average rate of earnings of 17.7 per cent on their petroleum business. Returns from 138 refining companies in all parts of the country showed an average rate of earnings of 20.0 per cent for 1919. Those refiners who made use of pressure stills for converting gas oil into gasoline enjoyed earnings of 25.2 per cent for 1919, while those not employing such processes earned at the much lower rate of 14.6 per cent. The earnings of the refiner varied inversely with the proportion of the crude petroleum consumption produced by themselves; for example, refiners

producing no crude petroleum showed earnings of 24.8 per cent in 1919; refiners producing from 0 to 20 per cent of their crude, earnings of 21.9 per cent; refiners producing from 20 to 50 per cent of their crude, earnings of 16.6 per cent; and refiners producing over 50 per cent of their crude requirements, earnings of 15.7 per cent.

6. The Commission in conclusion repeated certain recommendations which it made in a report to the House of Representatives on June 1, 1920,[1] namely, "(a) that the active support of the Government be given to those engaged in the oil industry to develop production in foreign countries; (b) that methods of drilling for petroleum and the utilization of petroleum products and their substitutes should be a subject of special study in technological and economic aspects with a view to conserving the supply; (c) that the great importance of information regarding changes in industrial and commercial conditions in the oil trade suggests the need of making provision for having such information currently collected and reported for the use of Congress, the public, and the industry."

The report represents an important contribution to our knowledge of the petroleum industry. It should prove useful to operating companies as a basis for comparing costs, and of value to all students and analysts of the petroleum situation. The scope of the investigation, as imposed by its authorization, however, limits the undertaking to an analysis of *results*, whereas, in the reviewer's judgment, an adequate solution of the problem cannot be reached without an evaluation of *causes*.

Joseph E. Pogue

*Market Statistics.* Prepared under the Direction of Carl J. West and Lewis B. Flohr. U. S. Department of Agriculture, Bulletin No. 982. Washington: Government Printing Office. June, 1921. 279 pp.

> "The statistics of this bulletin are based primarily upon the data of prices, receipts, shipments, inspections, and other figures of the marketing of agricultural products obtained by the Bureau of Markets in the conduct of its various reporting and regulatory services. Reports of other governmental bureaus have been drawn upon, particularly the Bureau of Crop Estimates for farm prices and farm crop estimates, and the Bureau of Foreign and Domestic Commerce, for exports and imports. In some instances material has been taken from recognized commercial sources to complete or round out the tables."

The remaining 273 pages are made up entirely of tables and occasional footnotes. The book is divided into six parts: 72 tables are devoted to livestock; 6 tables to dressed meats; 18 to wool; 24 to dairy products; 145 to grain, hay, feed, and seeds; 40 to fruits and vegetables; and 14 to cotton.

The total of 319 tables gives the marketing statistician a wide range of tables from which to select various statistical data. The 100 pages devoted to the 72 tables on livestock should give the searcher for detailed information on this subject the very information he seeks. The material on dressed meats is crushed into 29 pages, and various details have been omitted. For example, there is a table showing livestock slaughtered under federal inspection from 1910 to 1920. The title does not indicate whether the amount slaughtered refers to the entire United States or to some special city, but it is assumed that the reference is to the entire United States. And there is no table giving the same information for the several large slaughtering centers. Likewise, the table on cold storage holdings covers the entire country and gives absolutely no information as to the holdings in various cities. In fact, this table has been so well hidden from the public gaze that its discovery can be best made certain by the hunt and find method. Thus, if one wishes to find the cold storage holdings of beef, he will look in vain for that word in the main index. "Cold storage," "storage," or "holdings" likewise do not appear in the main index. Accidentally, one learns that in order to find the cold storage holdings of beef one must refer to the main heading "Meats," then find the sub-heading "cold storage holdings," and then the sub-sub-heading "beef." After one has thus explored for a number of topics which are hidden under sub-sub-headings, one feels that the cross references are very meager in the scanty index.

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[1] Report of the Federal Trade Commission in Response to House Resolution No. 501 on *The Advance in Price of Petroleum Products.* Washington: Government Printing Office. 1920.

To one familiar with the New York City markets, the words "butter, cheese, and" immediately bring to mind the word "eggs"; yet Part III deals only in "Dairy products, poultry and oleomargarine." The information under this heading is quite complete, but certainly a bulletin dealing with market statistics is incomplete without some reference to eggs. This omission is surprising in view of the fact that the federal department puts out daily reports on eggs.

The first table in Part V, dealing with apples, shows the monthly range and average jobbing price per barrel and per box at various markets. To the reviewer this table is of little value because it is too general. For example, the title of the table is "Apples." To which of the 80 varieties of apples that come to the market does the table refer? To a selected number or to the entire group? What is included under the term "range"? Is it intended to cover apples ranging from unclassified to A-grade extra fancy, or are only A-grade 2½ inch apples included? There is another puzzling part of this table which is entitled "average." The reviewer has been working on an article dealing with the prices of apples on the New York City markets and finds that the term "average" is entirely meaningless because there is no way in which an arithmetical average, mode, or median can be determined, since no agency records or can record the volume of sales. This term "average" is used throughout Part V, and there is the same objection to its use with regard to other commodities. In most instances, the criticism that has been made regarding the use of the price range in the case of apples is also applicable to other commodities.

It is to be regretted that those in charge of the bulletin did not see fit to add to the tables dealing with the receipts of fruits and vegetables at the various markets tables dealing with the receipts of grapes and lettuce. This omission is especially surprising in that the carload shipments of both grapes and lettuce have been included on previous pages.

Throughout this review the adequacy of this volume to investigators and students of the marketing problem has been kept in mind, and attention has been called to the various omissions in order that a more adequate bulletin may be circulated next year. In spite of its various omissions, this book should be on the shelf of every student of the marketing problem. It will also prove of value to instructors of statistics who are looking for material in a new and growing field of applied economics.

ARTHUR E. ALBRECHT

College of the City of New York

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*Competition and Combination in the Wholesale Grocery Trade in Philadelphia.* By William Lewis Abbott. Menaha, Wisconsin: The Collegiate Press. 1920. 87 pp.

That the present economic order is a coöperative one, will hardly be denied. But there exist within our economic organization many varieties of coöperation. Thus, one finds coöperation among the retailers in their merchant associations for the purpose of "charging what the traffic will bear"; among the building contractors in certain cities, for lowering wages and maintaining the prices of their products; and among the consumers themselves.

This monograph by W. L. Abbott is a study of coöperation as it exists in the wholesale grocery trade of Philadelphia. It appears that the development of the chain-store system in the retail grocery business, the growth of the mail order and the premium firm, the practice by certain manufacturers of selling directly to the retailer who can place large orders, and the elimination of the wholesale middleman by various large packers, has for years been making inroads upon the wholesaler's business. But this is not all. Obviously those retailers who are unable to buy directly from the manufacturer and thereby save the wholesaler's profits as well as the cost of maintaining the wholesale establishment (some 8 to 10 per cent of the value of total sales) cannot compete efficiently either with their more fortunate brethren within the trade or with the "obnoxious" low-priced chain store. So they too have invaded the realm of the wholesaler and have started coöperative buying associations with a purchasing capacity sufficiently large to enable them to get their merchandise directly from the manufacturer. There are two such coöperative associations in Philadelphia, and their combined yearly sales have been about $10,000,000.

This factor has been too much for the "legitimate" wholesalers, and they have formed their own associations to offset the coöperating retailers and have agreed to sell various "specials" with no profit to themselves, and often even at a loss. Prizes for the largest sales of products handled by the associated wholesalers have been awarded to their retail customers, and a system of premium distribution has been developed—but without avail. The coöperative retail associations have continued to flourish, and the coöperating wholesalers appear to have concluded that the former are here to stay.

The author believes that the coöperative retailers through their associations fulfil most of the functions of the wholesale grocer, and in a most efficient manner. In two ways, however, the coöperative companies fail, namely, (1) they do not finance the retail store (through the extension of credits), and (2) "they do little to promote the sale of goods and to introduce new articles." As to the significance of the latter, little need be said here. The economic waste of maintaining competing salesmen to promote the sale of both old and new goods has long been recognized. Bulletin No. 9 of the Bureau of Business Research, Harvard University, for example, shows that the largest item in the expense of maintaining the wholesale grocery establishment is the cost of the sales force, amounting to nearly one-fourth of the total expenses.

The question of financing is worthy of consideration. The small retailer has never been able to finance his enterprise through the medium of the bank. Either his lack of knowledge as to banking facilities or the absence of sufficiently sound paper has kept him from utilizing the credit resources of the banking world. It has been the function of the wholesaler, therefore, to finance in large part the average corner grocery store. The coöperative retail associations, however, virtually compel cash payments (their purpose being to keep their expenses down to the minimum by eliminating the cost of collections and the losses from bad debts), thus forcing their customers to finance themselves. This, of course, has made it less easy to start new retail stores, consequently cutting down the duplication of plant and capital and, indirectly, the cost of maintaining our retail distributive system.

In view of these facts one might easily agree with the author that the coöperative associations do not render one of the functions usually performed by the wholesale grocer. But one must realize, as does the author, that this is "not a cause for condemning them on the charge of inefficiency." It results "rather in an introduction of more efficient and economical business methods. Its net tendency is to restrict the business to those who have some capital and responsibility." The advantage of restricting any line of economic activity to those who happen to have capital in their possession cannot be considered universal, but most persons will assent to the justification of such action in the retail business. It is estimated that in 1910 Philadelphia had one retail grocery to every 59 families—a clientele sufficient to allow an annual income of $640 or less. When one realizes that the average large city apartment house contains anywhere from eight to thirty families it becomes questionable whether there is any justification for the existence of one grocery store to every 59 families. This same condition is prevalent, often in a more exaggerated degree, throughout the country. The state of Arkansas boasts of one grocery store for every 226 persons (an average of five persons to a family giving one store for every 45 families); Florida averages one grocery store for every 173 persons in the state; and an average for the entire country shows the distribution of grocery stores to be one for every 265 inhabitants. Indeed, over 1,163,000 persons, or approximately 2 per cent of those engaged in gainful occupations, spend their time distributing retail groceries.

As long as any person with a small sum of money—savings from a period of prosperity, an insurance policy, or money acquired from some similar source—can start a retail grocery store, three-fourths financed by the wholesaler, we may continue to look forward to two or three grocery stores in every city block (a half-dozen, even, on most Main Streets of country towns) and a constant procession of small store-keepers toward bankruptcy. In 1915 there were 3,614 failures of grocery stores; in 1916, 3,599; in 1917, 3,129; in 1918, 1,969; and in 1919, 1,359. For each year these failures comprised approximately one-third of the total mercantile failures in the country.

ISADOR LUBIN
University of Michigan

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*Statistics and Their Application to Commerce.* By A. Lester Boddington. London: H. Foulks Lynch & Company. 1921. xv, 220 pp.

Boddington's book on statistics and their application to commerce is the first attempt on the part of an Englishman, as far as the reviewer knows, to apply simple statistical methods to business, or more particularly to commerce.

The author in the Introduction reviews briefly the recent changes affecting business, and points out the need for the business man of today to study his problems scientifically. He regards business as a science, and the business office, therefore, as a laboratory in which much of the quantitative data growing out of business transactions may be used not only to test the results of past action, but also to indicate the future results of present business policies.

Regarding the application of statistics to business and the objects of statistics, the author comments as follows: "One of the objects of statistics is to supply a panoramic view of a large mass of facts accumulated from past experience, to coördinate and condense these facts into a form easily comprehensible to the man in the street, and to use the knowledge so obtained to assist present or future operations. If this definition of the object be admitted, then the usefulness of statistics to commerce cannot be questioned."

The volume is divided into two parts. Part I covers the Compilation of Statistical Data, and Part II, the Presentation and Uses of Statistical Data. Under Part I the author discusses "Business Statistics and Their Importance," "Compilation and Uses of Statistics," "Accuracy and Approximation," and "Types and Averages." Under Part II, the chapter headings are as follows: "Tabulation," "The Graphic Method," "The Graphic Method Applied to Commerce," "Index Numbers," and "Published Statistics and Their Use." It will be noted that the main topics found in current books on statistics are included. The only thing which impresses the reviewer as out of the ordinary is the treatment of tabulation after the discussion of types and averages. Concerning this order more is said later. A distinctive feature of the make-up of the volume is the inclusion of a synopsis in each chapter. This arrangement has certain advantages and might well be followed generally.

The book contains both tabular and graphic material designed to illustrate the various applications which the author makes of the principles discussed.

The emphasis given to the importance of units throughout the discussion is gratifying, the contention of the author being that little or no progress can be made in applying statistics to business or in interpreting current statistical data without full cognizance being taken of the units which are employed.

The volume has certain limitations, but attention is called to them without any desire to detract from the general value of the volume for the purpose for which it is written.

In the discussion of averages, the author seems to have misconceived the meaning of the arithmetic mean, and to have confused the arithmetic average and the weighted arithmetic average. On page 59 the author states: "A works employs three foremen at a wage of £20 per week each, and 120 workmen whose average wage is £1 per week. What is the average wage?

If we use the simple arithmetic average, we get:

$$\frac{\pounds 20+\pounds 1}{2}=\frac{\pounds 21}{2}=\pounds 10.5,$$

a result which is obviously misleading." To call the result of such a calculation as this a simple arithmetic average is to do precisely what the author tells us, in a similar example on page 56, ought not to be done. In the matter quoted immediately above, to multiply, as the author advises, £20 by 3 and £1 by 120 and to divide the result by 123 does not, in the reviewer's judgment, as the author states on page 60, result in securing a weighted average. Such a calculation as that resulting from adding £20 and £1 and dividing by 2 is meaningless. Merely to make the frequencies greater than unity, as may be illustrated by the following example, is not to make a simple into a weighted average:

| Rate | Frequency | Product | Frequency | Product |
|---|---|---|---|---|
| £20 | 1 | £20 | 3 | £ 60 |
| 1 | 1 | 1 | 120 | 120 |
|  | 2 | 2)£21 | 123 | 123)£180 |
|  |  | £10.5 |  | £1.463 |

The average, £10.5, does not fulfil the conditions described in the quoted matter. Moreover, to speak of £1.463 as a weighted and £10.5 as an unweighted arithmetic average is clearly an error. Other illustrations of the confusion between the two terms are found in the chapter on types and averages.

To speak of the median, as is done on page 68, in contrast to an arithmetic average as always being an "actual case in the data" appears to be an error for all discrete series having an even number of items. Not infrequently in data of this type there are no precise medians.

In enumerating the subject matter discussed in the volume, it was noted that the discussion of tabulation follows the consideration of types and averages. Such an order of treatment makes necessary considerable repetition and is hardly in keeping with the author's statement on page 76 that "The tabulation of results is really the final stage of the work of compilation, and subsequently becomes the basis for consideration, deduction, and application to present and future problems." Averages are precisely the means by which such consideration, deduction, and application are made and, since this is true, it would seem that they should be discussed after tabulation.

In several places terms are used which are not defined. An illustration of this is found on page 102 where "continuous series" are mentioned, but not defined. Moreover, the word "data" is used in various places with a singular verb.

The volume is replete with graphic figures, but many of them are poorly drawn, particularly so far as scales are concerned. On page 132 in Table R the author has clearly violated his own injunction that in tabulation things to be compared should be placed in juxtaposition. If the table had been made in keeping with this principle, the conclusion that the monthly sales cannot be compared with the accumulated sales would not follow. It is true that graphic presentation has certain advantages over tabular presentation, but these advantages are artificially stressed in this instance by the form in which the table is designed.

The last chapter, on "Published Statistics and Their Use," refers solely to railway statistics and hardly seems to justify the broad title used.

Probably the main interest of this volume to the American student is found in the chapter on index numbers. This includes a discussion of the make-up and peculiarities of each of the main English numbers and comments concerning the commercial uses to which these index numbers may be put.

HORACE SECRIST

Northwestern University

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*The American Railroad Problem.* By I. Leo Sharfman. New York: The Century Company. 1921. xiii, 474 pp.

The scope of Professor Sharfman's book is all that its name implies—*The American Railroad Problem.* It is primarily a study of the present-day railroad situation in the United States, but it does not avoid historical or economic analyses when they are essential to the reasoning or the exposition. The book is, therefore, much more than a mere study of war-time railroad operations. Indeed, it is Professor Sharfman's thesis that the problems which focused during the war can be clearly traced in the immediate pre-war years. The war situation did, however, inspire the writing of the book, and the experience of federal control is not treated merely as a separate episode. This fact is reflected by the sequence in treatment: a demonstration of the rise of the root problems, an exposition of their incidence upon war conditions, and an analysis of the proposals for their solution.

These root problems are three: "Unity of operation and railroad service; rates, credit and financial return; and railroad labor and continuity of operation." Fundamentally, all three are concerned with service. They correspond with the important additions to the regulative machinery adopted in the Transportation Act, 1920. Professor Sharfman considers each in turn, pointing out the origin of the problem, the previous attempts at solution, the reasons for failures to cope adequately with the difficulties, and finally indicating the method proposed in the Transportation Act, its limitations and possibilities. A concluding chapter discusses the experience since March, 1921. It cannot be said that Professor Sharfman is unduly sanguine that the Transportation Act has solved the railroad problem, once for all. He fully recognizes the ultimate issue. In conclusion he says: "The regulative method, as well as corporate ownership and private operation, is now undergoing its crucial test."

Perhaps it is too early to ask for an extended study of the results of federal control. But so much has been said and written that has been colored by prejudice and, conceivably, even by political desires, that the reviewer looked to Professor Sharfman's book for an impartial interpretation. Unfortunately, the treatment seems to lean too far to the side of charity: there is seldom criticism of the Railroad Administration or of the leaders of the labor organizations. There would be no present objection to this interpretation were it not for the statement that the chief contributions of federal control rest in the demonstration of "the possibilities of unified operation" and of "the constructive adjustment of labor relationships." In only one case is the comment unfavorable. It is questioned whether the miscellaneous "economies" inaugurated by the Railroad Administration—elimination of solicitation, unification of freight tariffs, consolidation of ticket offices, etc.—were such as to justify the important place given them by the Director General. The reviewer, for one, believes that it is doubtful if any very convincing conclusions looking toward the establishment of a long run railroad policy (involving fundamentally the issue of nationalization) can be drawn from an "abnormal period," when "many things were done and wisely done, which might deserve censure under normal conditions."

What the reviewer likes best about the book is that Professor Sharfman explains the basic economic principles, that he is not afraid to repeat these statements of economic principles, and that he has developed a logical outline and adhered to it. There is no other summary of the essential facts of railroad history since 1900.

HOMER B. VANDERBLUE

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*Field Work and Social Research.* By F. Stuart Chapin, Ph.D. New York: The Century Company. 1920. ix, 224 pp.

Professor Chapin in his preface calls his work a manual. In reality it has none of the qualities of a handbook. It is an exposition of the methods of data gathering applicable to social phenomena, together with a large amount of illustrative material exemplifying the successive points as they are presented.

The book contains little that is new. Through direct quotation and paraphrase the author presents much of the valuable material produced by the best writers on social research. In general the content is carefully chosen and well organized, and should be of real service to those who are approaching for the first time the subject of data gathering.

Beginning with a brief exposition of the inductive method and its relation to field work, he presents a somewhat detailed description of research method as used by the historian. No application of these principles is made to sources of quantitative data. A partial list of such sources is set forth, however, and the desirability of consulting these prior to gathering original data is shown.

Three types of field work are dealt with—(1) case work, (2) sampling, and (3) complete enumeration. Although the *individual* nature of case work is accented, its *non-statistical* feature is merely implied. It is doubtful if the average reader would gain any comprehension of the distinction between a case history, sympathetic and subjective in its minute details of descriptive information, and the impartial and objective quantitative individual schedule of statistics. Nor are the different uses of the two—individual aid and social analysis—made clear. In general, however, the technique of case work is well presented.

It is regrettable that Chapin has seen fit to include social surveys under the head "Sampling." A more logical and lucid arrangement would have placed his illustrations in his chapter on case work. The Pittsburg, Syracuse, and Springfield surveys were not samples at all and were not intended to be. All are case studies with the city as a unit. Other types than those cited, quantitative in nature and illustrating the rules he later lays down, have been made and could have been used in exemplification of true sampling. As it is, the reader is completely confused. The latter portion of this section contains a clear presentation of the procedure of sampling.

The chapter on "complete enumeration" consists solely of a detailed account of the Massachusetts State Census of 1915 and would have been much improved by the addition of a summary of principles similar to those included in most of the other chapters.

The most valuable portion of the volume is Part III which deals with special problems connected with field work. While the earlier chapters contain somewhat vague generalities and detailed illustrations, the last two chapters are made up of terse suggestions with pointed illustrations. They constitute the most complete analysis of schedule drafting and editing that has yet been produced and include excellent suggestions on classification and tabulation. Too little space is given to the mailed questionnaire and its peculiar difficulties, but otherwise the ground is well covered.

*Field Work and Social Research* is an excellent reference work for elementary classes in social research. It leaves room for a carefully prepared volume of rules and cautions for the practical guidance of the social surveyor.

FRANK A. ROSS

*The Economic Aspects of Geology.* By C. K. Leith. New York: Henry Holt and Company. 1921. xv, 457 pp.

*America's Power Resources: The Economic Significance of Coal, Oil, and Water-Power.* By Chester G. Gilbert and Joseph E. Pogue. New York: The Century Company. 1921. xiv, 326 pp.

The World War was the occasion for a group of significant books on the place of minerals in war and peace. Among the important American contributions to this field are Eckel's *Coal, Iron, and War*, a revision of Finlay's *Cost of Mining*, the *Geological Survey's World Atlas of Commercial Geology*, and *Political and Commercial Geology* by Spurr and others, not to mention the studies of the Fuel Administration, the Federal Trade Commission, the War Industries Board, and the Treasury Department. The war not only brought with it new problems challenging attention, but incidentally developed a fund of quantitative data concerning the mineral industry which otherwise could never have been brought together.

In this growing literature of mining economics the two works under review deserve an important place. The purpose of Professor Leith's book is "to explain the nature of the economic demand for the science of geology, and to discuss something of the philosophy of the finding and use of raw materials." The scope and the manner of treatment follow somewhat the author's presentation of the subject in the classroom. Professor Leith's qualifications for his task are exceptional. To a distinguished record as teacher and contributor to the science of geology, he has added an extensive consulting practice and war-time service as mineral adviser to the Shipping, War Trade, and War Industries Boards.

The field covered by the work is broad. The introductory chapters summarize briefly the geology of mineral deposits. The body of the book is devoted to discussion of the minerals of economic importance, each of which is treated under two headings, "geologic features," and "economic features." Additional chapters deal with methods of exploration, valuation, taxation, laws relating to minerals, conservation, international aspects of mineral resources, and geology in war. In such a wide range of subject-matter absolute accuracy is unattainable, and that occasional errors have crept in is evidenced by the statement on page 118 that South Carolina has important reserves of coal. Nor was it to be expected that the book would contain only new matter. The statistical material is for the most part quoted from familiar sources, with the exception of the data presented in Chapter IV, "Some General Quantitative Considerations"—one of the most interesting and valuable parts of the work. In the discussion of the several minerals many sources have been drawn on, and even the more general chapters on economics are largely revisions of papers previously issued by the author himself.

Nevertheless, there is much about the work that will win for it an accepted place. The treatment is remarkably compact, simple, and stripped of irrelevant details. The style is incisive and forceful. If not used as a textbook by teachers of economic geology, the volume will surely be valuable as a reference work. The mining fraternity will read it for its economics, and the student of commercial geography or of the theory of production will find it the best general description of the world's mineral resources that has yet been written.

*America's Power Resources*, by Pogue and Gilbert, is a very different type of book. It is analytical rather than descriptive, with a central theme and an argument directed to a definite end. The thesis is the need of a "coördinated development of our energy resources" which will (1) eliminate the present appalling wastes in production, (2) transport energy more effectively, and (3) "utilize our energy materials so as to insure a higher recovery of the energy content and a proper employment of the commodity values." The first result is to be attained by integration of mining operations, the second by the development of a common-carrier system of energy-transmission lines, and the third by "furtherance of multiple production, coupled with adequate attention to the efficiency of appliances concerned in utilizing energy."

The authors show that the rapid increase in the mechanical energy at the command of the United States has been the chief element in our material progress. Interesting, though perhaps above the mark, is the calculation that it would take the labor of three billion slaves to accomplish the work done annually by our energy resources.

The book is a revision of Bulletin No. 102 of the United States National Museum, and it has been improved by the revision. It is written in non-technical language. The style is somewhat labored, but so suggestive and stimulating is the subject-matter that the book should have a wide appeal.

The important contribution of the authors is their insistence on the necessity of viewing coal, petroleum, gas, and water-power as a common source of energy, and their courage in outlining a coördinated plan for energy development.

F. G. Tryon

United States Geological Survey

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*A History of Life Insurance in the United States to 1870; with an introduction to the development abroad.* By Charles Kelley Knight. Philadelphia: University of Pennsylvania. 1920. 160 pp.

A history of life insurance, in this or other countries, is not an easy thing to write. It involves a consideration of many factors, actuarial, economic, and sociological—the mathematical foundation of the business; the development of a successful system of organization and management; and the education or self-education of the public in the uses of such an institution. Most of the historical material thus far published in the United States has been either encyclopedic in character or devoted to the glorious details of the past of some particular insurance company. It remained for some one with an interest in analysis and a judgment of significant detail to sift from the mass of facts the broad outlines in the development of life insurance in the United States.

This, I judge, has been the author's purpose. There are two methods of writing such a history, the topical and the chronological, each of which has its advantages. The chronological method has been chosen. An intimation is given in the preface that a process of selection is followed in order to place in relief the history of enduring features of life insurance, and also the "false practices that might recur at some future time"; the "disreputable practices that have been permanently abandoned" have been omitted.

The book contains five chapters: the first is devoted to the development of life insurance abroad, and the remainder are confined to the United States. This preliminary chapter does not carry foreign developments down to the present time or involve any comparison of American and European conditions, but gives, rather, a background of developments in the field before 1800—the basis on which our early attempts to insure lives were built. This period is divided into four stages: (1) the period of experiment; (2) the speculative assessment period; (3) the era of scientific progress; and (4) the advent of modern life insurance. In this early period the foundation of the science of life contingencies was laid, the plan of tontine contracts was developed, and assessment insurance was begun.

The remaining four chapters of the book are devoted to life insurance developments in the United States prior to 1870. Chapter II covers a fairly dull and uninteresting part of this development, the years to 1809. The great commercial development of the business had not begun; some insurance was written, on a short term basis, by individual underwriters and by religious societies; some corporations had actually written life insurance, but only as an adjunct to the fire and marine business for which, principally, they were organized, and they made no attempts to *solicit* life risks. The first American mortality table appeared in this period, published in 1789 by Professor Wigglesworth, though it was not used at this time as a basis for calculating life insurance values.

Chapter III covers the years 1809–43, called by Dr. Wright the proprietary period. Commercial life insurance, by stock companies, on a sound actuarial basis was begun, but methods of selling insurance were little developed and the amount of insurance written was small.

I suspect that most readers of this book will find the greatest interest in Chapters IV and V, covering respectively the years 1843–61 and 1861–70. In the first period came the great development of mutual insurance, with the formation of companies such as the New England, New York Life, and Mutual Life, companies which are still writing insurance and which have been highly successful. It is particularly interesting to note during this period the high correlation between new companies established and business prosperity. During the later 40's a great number of new companies were organized, but very few of them are in existence today. These facts emphasize the three-fold character of successful life insurance—actuarial soundness, competent management, and ability to secure business. We have an excellent counterpart in the development of life insurance since 1900.

The period 1861–70 found the companies equipped with most of the instruments of successful underwriting—financial soundness, an agency system, and a fund of experience gained through the successes and failures of previous years. The coming of the Civil War emphasized the need for life insurance and flooded the country with securities seeking investment. The result was a tremendous growth in the development of the business.

It is to be regretted that the story ends with 1870. At this date the really great developments in American life insurance were just beginning. The great growth of fraternal insurance was still to come, and the liberalizing of the policy contract was scarcely begun (and the contract is one of the best things about the business today—such a complicated document that not one prospect in a hundred understands it and yet the interests of the insured are very thoroughly guarded by it). Finally, ending as it does in 1870, the story must leave out any but a bare glimpse at the personalities of a few great men who have helped to mold the character of the institution. Elizur Wright was just coming into prominence as this story closes, but American life insurance history cannot be fully told without extended reference to his great work as Insurance Commissioner in Massachusetts.

Bruce D. Mudgett

*Mathematics of Finance.* By Henry Lewis Rietz, Arthur Robert Crathorne, and I. C. Rietz. New York: Henry Holt and Company. 1921. xii, 280 pp.

This text treats the following subjects under mathematics of investment: interest, discount, annuities certain, sinking funds, valuation of bonds, depreciation, and building and loan associations. The treatment of interest, discount, and annuities certain does not differ greatly from that of Skinner's text. The balance of the text, however, is more elaborate than Skinner's; the subjects are the same but the treatment is more thorough. This is particularly true in the case of depreciation, and of building and loan associations.

The introduction to actuarial mathematics is far more satisfactory than that usually found in elementary texts on finance. Certain fundamental propositions of probability having a direct bearing on the subject are developed and followed by an elementary treatment of the mortality table, probabilities of life, life annuities, and, finally, premiums and reserves in life insurance.

A chapter on the theory and use of logarithms and one on the progressions are added to the text for the benefit of students who have not previously studied these subjects, which are essential to an understanding of the text proper. Tables of interest and mortality functions, sufficiently extensive for textbook purposes, are added.

The text does not, and is not meant to, cover the subjects of theory of interest and actuarial mathematics in so thorough a manner as the texts of the Institute of Actuaries, since to do so would presuppose a knowledge of finite differences and calculus. What it does endeavor to do, and what it succeeds in doing, is to present a text on the mathematics of finance exceedingly well adapted to the needs of students of business administration, whose knowledge of mathematics is generally limited to freshman algebra.

Harry C. Carver

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*Population and Its Distribution.* Compiled from the figures of the 1920 Census by the J. Walter Thompson Co. New York. 1921. x, 335 pp.

This is a handbook of certain types of statistics of the United States especially valuable to manufacturers, wholesalers, and salesmen, but also occasionally useful to almost every one. Its contents include a study of the area, number of inhabitants, and density of population of the various states; a comparison of the population in 1910 with that of 1920 for all the leading cities; a record of the division in 1920 of the population of the various states into urban and rural, foreign-born, etc.; a statement of the population in 1920 of all the towns and villages of the country; and an estimate for each state of the number of farms, the number of post offices, the miles of roads improved and unimproved, the miles of railway line, the number of motor cars registered, the number of telephones, the number of central electric power stations, and the number of houses wired for electricity. The relative incomes of the various states and cities are illustrated by giving for each the amounts reported for taxation and the total of subscriptions to the Fourth Liberty Loan. A unique feature of the book is an estimate of the number of each type of retail establishment in the different states and cities of the country.

The book is printed in clear type on good paper, is neatly bound, and its contents are conveniently arranged for reference. It is a book that many business men will desire to keep near their desk.

WILLFORD I. KING

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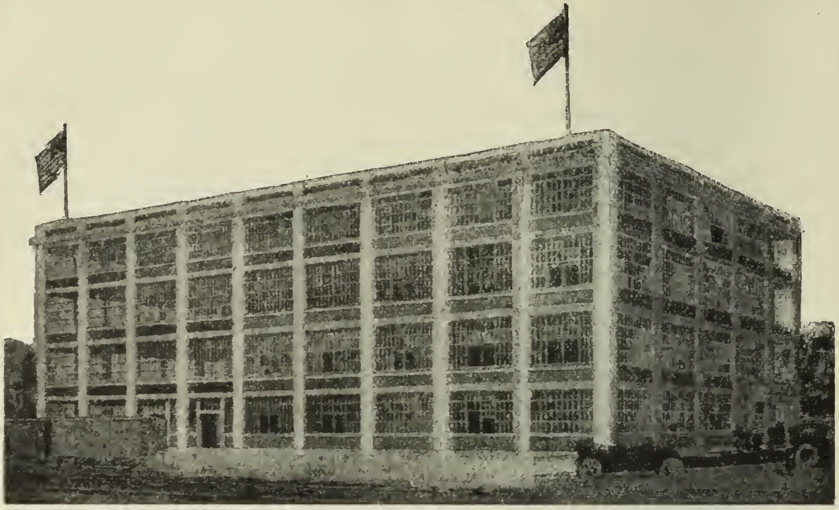

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# THE PLACE OF CORPORATE SURPLUS IN THE NATIONAL INCOME[1]

BY OSWALD W. KNAUTH

## INTRODUCTION

Some years ago Professor David Friday made an estimate of national savings, in the course of which he drew particular attention to the large total of the savings of corporations.[2] The totals which he arrived at were far larger than had been currently believed, both for national savings and for the savings of corporations, and he pointed to the need for further investigation along these lines.

Some time later Mr. W. R. Ingalls, in a series of excellent articles published in the *Times Annalist,* [3] made a similar computation, as a result of which he called into question Professor Friday's large estimates and showed that the amounts actually saved by corporations were about half as large as those shown by Professor Friday. My assignment is a further discussion of the same topic.

Savings are originally made by individuals, corporations, or governments, and are used for more or less durable goods, as opposed to articles immediately consumed. Accordingly their value should show up in any national balance sheet. Such a balance sheet has been drawn up by Mr. Ingalls covering the years 1916 and 1921. He estimates the capital wealth of the country at these two dates respectively at $268,000,000,000 and $270,000,000,000. If his figures are accurate, then in a national sense there was practically no "saving" during this period — all our surplus having been used up directly or indirectly in the course of the war and the economic disturbance following it.

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[1] Read at the Eighty-third Annual Meeting of the American Statistical Association at Pittsburgh, Pa., December, 1921.

[2] David Friday, *Profits, Wages and Prices*, p. 64.

[3] September 20, 1920.

From an individual viewpoint, however, real saving took place, only it involved a redistribution of the same assets rather than an increase of assets. The individuals who saved and bought Liberty Bonds are richer; but their wealth is in the form of an obligation on the part of the nation, which has to pay taxes to cover interest and has no increased income with which to do it. These savings were no less real because they were expended by the government or lost in the depression of 1920 and 1921, for had they not existed we should be facing an actual impairment of our capital equipment instead of its virtual maintenance. What the nation has today is a heavier mortgage than before the war, mainly in the form of Liberty Bonds, on a practically unchanged base of national wealth. From the individual viewpoint, then, savings by individuals and corporations are quite as real as they were when actually represented by an increase of national assets.

## DEFINITION OF CORPORATE SURPLUS

It is well at the outset to give a precise definition of what I mean by corporate surplus.

The surplus of a corporation is that amount of its net earnings which remains after the payment of all expenses, including the various classes of reserves, maintenance charges, taxes, and dividends.

By defining the term in this way we avoid all possibility of including anticipated losses, and bring it down to the actual surplus which is added to the net corporation capital during any period of time. Although this definition is apparently simple, its application in practice is confused by the divergence of methods of accounting among different corporations. The actual conduct of business and the ability of business men to make accurate estimates from year to year vary widely. The reported surplus is nothing more or less than an estimate of accountancy, and is subject to all the limitations and errors which creep into the usage and necessary rules of thumb upon which the principles of accounting are based.

These variations of accounting principles necessitate inquiry into the profit and loss balance sheet of individual corporations. The asset value of the fixed property may be kept at the same amount each year, despite all market changes. The property may be over-maintained or under-maintained. Losses may be written off in one year, or spread over a series of years. From a long-time point of view, these various accounting practices do not make a business actually profitable or unprofitable; but at any particular time, and often for a considerable period, they may distort the picture. An excellent example came to my attention recently. A certain mine had sunk two shafts and connected them with an underground passage. In the course of time each shaft was enlarged so that they finally joined, and the passage ceased to exist. Nevertheless, in the valuation of the capital assets, for years after, these items were carried as (1) value of shaft No. I, (2) value of shaft No. II, and (3) value of passage. Just as the surplus of each individual corporation is thus open to question, so is the aggregate amount. Whether the statistician's hope that an average may wipe out all particular irregularities is justified will be taken up later. For the moment it can be stated that no particular case or even small group of cases may be considered as typical of the whole. Indeed, the opposite is true, for there seems much evidence for the conclusion that such great classes as mining, manufacturing, and railroads follow quite different practices in accounting.

### CORPORATE SURPLUS AND OTHER CAPITAL

In so far as the surplus that is carried on a corporation account as a liability is represented by a real addition to the assets of a similar amount, it is on the same basis as the other liabilities of a corporation. That this is true is recognized in common practice by the frequent interchange of surplus for capital stock. Indeed, the fundamental similarity of all forms of corporate liabilities, surplus, stock, funded debts, notes, and short-time debts, renders possible a considerable amount of interchange through the funding of short-time debts into long-time bonds, the conversion of bonds into stock, and the issuance of stock in place of surplus. These financial expedients have to do with the immediate solvency of a corporation, but they do not alter its assets or its earning power, except in so far as they permit the prosecution of continued policies. From the point of view of representing assets, then, there is no theoretical fundamental difference to be found between surplus and other classes of capital.

The question of the "reality" of the amounts carried as surplus may be tested in a fairly practical way. It has already been pointed out that the practices of corporations vary, not only as between themselves but also from year to year. In order, therefore, to test out a broad generalization, five groups of corporations were found whose records extended over ten years. The ten years chosen were 1905–14 because during this period prices did not move violently. This period was divided into two parts, 1905–09 and 1910–14, and the yearly averages of "capital employed" and "gross business" for each part were found. In this way the peculiar fluctuations of a single year, and to some extent of the business cycle, were removed. The average rise in prices for the second period over the first was 9 per cent—an amount which will not of itself distort the comparison greatly. At least it is the period of smallest price changes during which adequate published records are available.

If the growth of volume of business is expressed in terms of the percentage of the growth of capital for each of these groups, then the percentages are as follows: 1.08, 1.06, 1.05, 0.98, and 0.90, the average being $1.01\frac{2}{5}$ per cent. The indication of this trial, therefore, is that the growth of capital is accompanied by a growth in the volume of business of practically the same extent, and that in so far as surplus is a part of this capital its contribution is the same as any other part. Conclusions drawn from samples are dangerous, however, and this test is only indicative; but it is corroborated in a general way by other data. For instance, when the growth of primary horsepower between 1904 and 1914 is taken as 100, the growth of capital employed in manufacturing reported by the census (a most unreliable figure) is 84.2. I do not place much reliance on this by itself, but in a general way it corroborates the conclusion of a close relation.

In so far, then, as there is any relationship at all between accounting practice and the physical realities which they reflect, my conclusion is that there does not seem to be any reason to question surplus more than the other items in the corporate balance sheet.

With this conclusion Mr. Ingalls disagrees. He emphasizes the losses which are incurred by every going business, and considers that a proper discrimination will show that surplus in many cases is closely akin to a reserve account rather than an increment to capital. This is a generalization very difficult to prove or disprove, especially in a period of such wild price fluctuations as we have recently passed through. It is, finally, an accounting problem, and accountants have been having a difficult time in their attempts to give a true valuation of assets and liabilities.

The writing down of assets in 1921 has proceeded regardless of distinctions between surplus and capital on the balance sheet; and I should rely on an accurate accounting of real surplus in the year it occurred—to be wiped out, if necessary, by loss in the year when it occurs—rather than on a leveling out of income which minimizes both gain and loss.

Perhaps the above contention requires some modification. That corporate surplus is not considered to be quite on a parity with other forms of capital is indicated by the uses to which it is put by directors. They are more likely to take "fliers" with their surplus than with their capital; often these "fliers" prove disastrous. Ornaments to buildings or factories, hazardous advertising campaigns, experiments, questionable extensions of plant, and waste effort of various kinds are not undertaken until they can be paid for out of surplus. There is some information that points to the possible conclusion that the return per dollar on surplus is less than on paid-in capital.

For quite another reason this smaller return is typical of public utilities. Although it is difficult to generalize, I venture the statement that only rarely do commissions allow an increased rate sufficient to yield an adequate return on the surplus put back into the property.

Another difference is that surplus is commonly used as a buffer to business losses. It is the first item, after specific reserves, to be written off. There is scarcely a corporation that has not been forced to take large losses of this kind in the last year or two. Does this mean that these amounts were not earned in the first place, and should never have been considered as part of the capital? Clearly not, because the gains of yesterday were no less real because there are losses today; indeed, it would not have been possible to write off these losses without impairment of capital unless the previous gains had been there. To refuse to take account of real income in any year because it may be lost in the future would give a false picture. It would show a more uniform total income in each year than is actually realized.

### THE PERCENTAGE OF REAL SAVINGS

Taking into consideration the results of the inquiry noted above, and putting with these results common knowledge, I believe it is safe to conclude that between 80 and 90 per cent of the reported surpluses may be considered to be real savings. The evidence might be construed into an even higher percentage, but the unknown factors of possible losses are such as to make an understatement preferable, rather than to take chances on an overstatement. For purposes of computation, 85 per cent of the reported surplus has been used.

In this connection a further element of uncertainty should be pointed out. The practice of forming private investment corporations for the purpose of avoiding personal income tax has increased tremendously since the armistice. Concerning these corporations no generalized information is available. Every one must depend on the few samples that may come in his path. It appears probable that during the war personal income taxes were reported without a great deal of evasion, but since the armistice technical devices for evasion have multiplied at an astonishing rate. Among these is the formation of private investment corporations which retain all their earnings except such as are necessary for the living expenses of their stockholders. What the surpluses that are put aside in this way may amount to it is impossible to state. But they are doubtless large.

And the argument that income taxes are not evaded but are merely postponed will not hold; for it is in the hope that the present high rates will be materially reduced that these methods are practiced. It may be that this affords a partial explanation for the reduction in large incomes reported by the Bureau of Internal Revenue. The number of persons reporting incomes over $100,000 for 1916 and 1919 are respectively as follows:[1]

| | | | |
|---|---|---|---|
| 1916 | 6,633 | 1918 | 4,499 |
| 1917 | 6,644 | 1919 | 5,526 |

During this period the total number of income taxpayers was increasing rapidly. It is difficult to know what effect to ascribe to this one cause, for there were so many other influences at work—some of which also tended to reduce the reporting of large incomes—that the matter is confused beyond the possibility of close analysis. But there seems little doubt that legal evasion through the formation of private corporations was one of the strong influences at work. This applies especially to the 1918 and the 1919 returns after the war was over. One would have expected, in view of the rise in prices, an increase of large incomes over 1917 and perhaps over 1916. The probabilities are, therefore, that the surpluses retained by private corporations are greater in proportion than those of the business corporations which have been used as samples in this report.

## THE METHOD OF ESTIMATING TOTAL SURPLUS

The method employed for estimating the total surplus which corporations laid aside in each year was as follows:

Sample corporations, based on the ability to find adequate records over a period of years, were used for each industrial division, and the amounts actually paid in dividends and carried forward as surplus were recorded. No reserves of any kind were included in this surplus.

The number of corporations used as a sample were as follows:

| | |
|---|---|
| Industrial | 205 |
| Public Utilities | 62 |
| Commercial | 15 |
| Banking | Reports of Comptroller of the Currency |
| Railroads | Reports of Interstate Commerce Commission |

The percentage divisions between dividends and surplus for each group were weighted in accordance with the total earnings of that group, and the average percentage division found for each year. This percentage was then applied to the total net earnings of corporations as reported by the Bureau of Internal Revenue, and adjusted to accord with changes in the law. These adjustments covered: (1) The reporting at first only of corporations having a net income over $5,000, and later of all corporations; (2) the inclusion or exclusion of intercorporate dividends, the method being changed several times; (3) the non-reporting of deficits in the earlier years and their inclusion in the later; (4) the collection of back taxes after an audit which indicated total income for a past year greater than at first reported.[1] An estimate that was frequently a "best guess" was made for each of these items in each year, and the resulting total used.

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[1] *Statistics of Income*—1916–7–8–9.

The percentages of earnings paid out as dividends and hence also the percentages retained as surplus by the different industrial groups showed a wide variation, and the percentages for each group fluctuated greatly as between years. Financial corporations in 1915 paid out 89 per cent of their earnings as dividends, as against 52 per cent in 1920; manufacturers paid 79 per cent of their earnings in 1914, as against only 37 per cent in 1916; public utilities had their lean period in 1918, when they paid out 87 per cent of their earnings, as against 61 per cent in 1910; and railroads in 1914 paid 92 per cent of their earnings, as against only 42 per cent in 1916.

The full table showing the proportions of net earnings paid as dividends and retained as surplus in each class of corporations for each year, is as follows:

THE PROPORTIONS INTO WHICH NET EARNINGS ARE DIVIDED BETWEEN DIVIDENDS AND SURPLUS

(D=Dividend; S=Surplus)

| Year | Financial institutional[a] | | Commercial[b] | | Manufacturing and Mining[c] | | Public Utility[d] | | Railroads[e] | | Weighted average | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | D | S | D | S | D | S | D | S | D | S | D | S |
| 1910[e]...... | 69 | 31 | 55 | 45 | 55 | 45 | 61 | 39 | 62 | 38 | 58.8 | 41.2 |
| 1911...... | 73 | 27 | 63 | 37 | 63 | 37 | 68 | 32 | 72 | 28 | 66.6 | 33.4 |
| 1912...... | 81 | 19 | 67 | 33 | 67 | 33 | 73 | 27 | 82 | 18 | 71.9 | 28.1 |
| 1913...... | 74 | 26 | 67 | 33 | 67 | 33 | 74 | 26 | 73 | 27 | 69.5 | 30.5 |
| 1914...... | 81 | 19 | 51 | 49 | 79 | 21 | 76 | 24 | 92 | 8 | 77.9 | 22.1 |
| 1915...... | 89 | 11 | 44 | 56 | 45 | 55 | 67 | 33 | 86 | 14 | 56.2 | 43.8 |
| 1916...... | 73 | 27 | 34 | 66 | 37 | 63 | 63 | 37 | 42 | 58 | 42.7 | 57.3 |
| 1917...... | 65 | 35 | 41 | 59 | 47 | 53 | 75 | 25 | 52 | 48 | 50.2 | 49.8 |
| 1918...... | 61 | 39 | 49 | 51 | 55 | 45 | 87 | 13 | 65 | 35 | 56.9 | 43.1 |
| 1919...... | 56 | 44 | 35 | 65 | 56 | 44 | 81 | 19 | 56 | 44 | 63.1 | 36.9 |

[a] Based on National banks. Reports of the Comptroller of the Currency.

[b] Based on 15 Commercial Corporations reported in Moody's Manual from 1914 to 1919. Previous to 1914 the reports are inadequate, and the manufacturing ratio is used.

[c] Based on 205 Corporations, reported in Moody's Manual and supplied by certain banking institutions. These ratios are also applied to "Miscellaneous" Corporations.

[d] Based on 62 Public Utility Corporations, reported in Moody's Manual.

[e] Based on reports of Interstate Commerce Commission and reports in Moody's Manual, covering practically all railroads.

[1] For full details, see *Income in the United States*, Vol. II, Chap. 25, published by the National Bureau of Economic Research.

With the limitations both of definition and of the possibility of accurate measurement in mind, the surplus of all corporations for each year since 1910 may be estimated as follows:

| | Million dollars | | Million dollars |
|---|---|---|---|
| 1910 | 1,200 | 1915 | 1,600 |
| 1911 | 900 | 1916 | 3,900 |
| 1912 | 900 | 1917 | 3,400 |
| 1913 | 1,000 | 1918 | 1,700 |
| 1914 | 500 | 1919 | 2,000 |

In 1920 the figure is probably about one billion dollars, and a guess at 1921, made from a variety of advance estimates and partial earnings, puts the figure at less than one-half billion dollars.

In terms of percentage of the national income, we have an extreme range from less than 2 per cent in 1914 to 8 per cent in 1916, with a normal of about 4 per cent. Our total savings seem to be about 15 or 16 per cent of the total income according to a recent estimate by Mr. Willford I. King; and corporation saving is about one fourth of the total. It is therefore a highly important item.

## ECONOMIC EFFECTS OF THE RETENTION OF SURPLUS

The policy of retaining a part of the corporate earnings appears to have grown up without any real thought of its fundamental effects. Today it is taken for granted that no corporation shall pay out more than a fraction of its earnings. Probably the first idea was to ensure dividends for the lean years. It is a matter of pride to point to an unbroken dividend record, and annual changes in the rate are not desired by any one; but surpluses are not retained entirely in the liquid form necessary to ensure the fixity of dividends, being often used to increase the fixed assets.

What have been the effects of this policy, especially as compared to the opposite policy of automatically paying out all the earnings each year?

The stabilization of dividends leads to a more certain return to the stockholder than would varying rates, and gives to many securities an appearance of being semi-investments through the actual payment of the same rate of dividends over a considerable period of time. Many securities do not really possess this quality. Examples of this are sufficiently familiar to all of us. But it has more important aspects than this: (1) It gives to the managements unobstructed control of new funds which amount normally to one fourth of the total national savings; and (2) it makes it very difficult for an outsider to judge the real value of a concern. Both of these results are incidental to the increased stability which this unconscious form of saving brings about; yet they affect the business structure to a marked degree.

The reinvestment through surplus in copper mining brought that industry into a serious crisis of over-production. Between 1915 and 1918 practically no outside money was put into copper mining in this country, Anaconda being the only company that sought new funds, and this largely for extension in other fields. In the same period, smelting capacity increased from 20 million tons of ore to 22½ million tons; refining capacity increased 58 per cent, or from 1,768 million pounds to 2,794 million pounds; and copper production rose from 1,250 million pounds to about 2,000 million pounds, or 60 per cent. These increases were due almost entirely to the reinvestment of the large war earnings. Probably the public could not have been persuaded to subscribe the new money for them so easily as were the over-enthusiastic managers. A similar condition occurred in zinc mining, and to a less degree in iron and steel. This magnified desire of American business men to expand their business at the expense of personal savings and even comforts has become a national characteristic in the same sense that family thrift and saving is strikingly exemplified in France.

## IS CORPORATE SURPLUS REFLECTED IN STOCK QUOTATIONS?

There naturally arises the question as to whether corporation surpluses are not accurately reflected in the quotations of the stocks of companies, and whether they do not in this way become a part of the incomes of individuals who own these stocks. If this be the case, then an inclusion of corporate surplus as a separate part of the national income which is added to the incomes of individuals would bring about a double-counting, provided that individuals sold their stocks.

Although this might be the case it probably was not during the last four years, for the following reasons: (1) The great rise in income tax rates caused many persons to refrain from selling stocks which had advanced in price; (2) the amounts reported by the Bureau of Internal Revenue as "income from sales of investments" are surprisingly small —1917, 316 million dollars, and 1918, 291 million dollars; and (3) the increase of stock values in 1919 was due not so much to the retention of surpluses as to the enhanced value of all prices of materials on hand and the expectation of permanently larger profits. For the most part, it appears likely that stocks and property were retained by their owners long enough for them to watch their values fall off in 1920 and 1921. The proposed high tax rates will probably continue to operate against the cashing in of profits due to an increase in property values; but if the rates are lowered, it may well be that this judgment will have to be revised.

## CONCLUSIONS

1. The policy of corporations in retaining part of their earnings leads to important national savings.
2. The amount of these corporate savings varies widely from year to year according to the prosperity or the depression of business.
3. These savings constitute about one fourth of the total savings, and about 4 per cent of the national income.
4. They are far more than stabilizers of dividends in that they largely increase the power of the managements of corporations in guiding the growth of industries in this country.

# A SUMMARY OF THE RESULTS OF THE 1920 CENSUS OF AGRICULTURE[1]

By Leon E. Truesdell

## INTRODUCTION

The general policy adopted for the Fourteenth Census was to make available the results of the census as early as possible, with little or no attempt at analysis or even at explanation, except where explanation was absolutely necessary to the understanding of the figures. In other words, the main task assigned to the Census Bureau was to supply the raw material, and to make it available for the use of other agencies in the shortest possible time. In this paper I shall present a few samples of this statistical material, with suggestions as to their possible significance.

## NUMBER OF FARMS AND FARM ACREAGE

The total number of farms reported for 1920 was 6,448,343, which represents an increase of only 1.4 per cent over the number of farms reported in 1910. This slight net increase is the result of considerable gains in some of the western and northwestern states, partly offset by losses in most of the older agricultural states. In the state of Montana, for example, there were more than twice as many farms in 1920 as in 1910. In Wyoming the increase was 43.3 per cent; in Idaho, 36.7 per cent; in California, 33.4 per cent; and in Colorado, 29.8 per cent. These increases were largely offset by decreases in the number of farms in all of the states east of the Mississippi River and north of the Ohio, except Wisconsin.

The total area of land in farms increased from 878,798,325 acres in 1910 to 955,883,715 acres in 1920, a gain of 8.8 per cent. The increase in acreage, like that in number of farms, was the net result of a large increase in the western part of the country, partly offset by decreases in the East.

In several of the eastern states, notably in New England, the decrease in the number of farms and in the farm acreage revealed by the census of 1920 is only a continuation of the decrease which has been going on for two, three, or more decades. To some extent, at least, the decrease in these states represents the giving up of farm land which cannot be profitably operated under present conditions, or of what might be termed sub-marginal land. Some of this land would have been given up long ago if its owners had realized its unprofitableness. Much of it is now growing up to timber, and it will prove more profitable for this purpose than it has been for agriculture in recent years.

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[1] Read at the Eighty-third Annual Meeting of the American Statistical Association at Pittsburgh, Pa., December, 1921.

### FOREIGN-BORN FARMERS

The total number of foreign-born farm operators in the United States decreased from 669,556 in 1910 to 581,068 in 1920, or 13.2 per cent. The number of farm operators who were born in Germany alone declined from 221,800 in 1910 to 140,667 in 1920, a decrease of 81,133, or 36.6 per cent. Notable decreases were also shown in the number of farm operators born in England, Scotland, Wales, Ireland, and Canada. In all these cases it may be presumed that the principal cause of the decrease was the fact that the men returned to their native countries for war service. On the other hand, there were considerable increases in the number of farmers from the Netherlands, Poland, Hungary, Russia, and Italy.

### FARMS BY TENURE

Of the total number of farms in the United States in 1920, 2,454,804, or 38.1 per cent, were operated by tenants, as compared with 37 per cent in 1910, 35.3 per cent in 1900, 28.4 per cent in 1890, and 25.6 per cent in 1880. It thus appears that while the percentage of farms operated by tenants is still increasing, the increase during the last decade was not so great as that which took place in any of the earlier decades for which figures are available.

In all of the states of the New England and Middle Atlantic divisions there was a decrease in the percentage of tenancy, continuing a tendency which has been evident since 1900 or earlier. In some of the states of the far West there were considerable increases in the percentage of tenancy, though even now both percentage and actual number of tenant farms are small. The percentage of tenants among the farmers in North Dakota increased from 14.3 in 1910 to 25.6 in 1920; in South Dakota from 24.8 to 34.9; and even in Iowa the percentage increased from 37.8 to 41.7. In the South as a whole the percentage remained unchanged at 49.6, and among the 16 southern states only 6 showed an increased percentage of tenants.

In the existing economic conditions there are several factors which would normally tend toward a continued increase in tenancy. The supply of free land is exhausted, and the rapid advance in farm-land values during the past 20 years has made it increasingly difficult for a young man to become a farm owner. Perhaps, then, instead of feeling pessimistic because there were 100,128 more tenant farms in the United States in 1920 than there were in 1910, one should feel optimistic because the increase has not been 200,000 or 300,000.

### NEW TENURE CLASSES IN THE SOUTH

In the census of 1920 two new tenure groups were added to the classification of farms by tenure in the southern states. Standing renters were separated from cash tenants, and croppers were separated from other share tenants.

Standing renters were defined as tenants who paid for the use of the land a fixed quantity of some product, rather than an amount in cash. The number of standing renters in the South in 1920 was 104,996, and the number of cash tenants, 219,188.

The most important difference between the cropper and the regular share tenant lies in the greater degree of supervision exercised by the landlord in the case of the cropper. As a convenient means of classification, however, croppers were defined as share tenants to whom the landlord furnished the necessary work stock. The number of croppers in the South was 561,091, and the number of regular share tenants, 651,224.

It has been claimed by some writers that croppers ought not to be considered as tenants at all, but rather as hired hands receiving their payment in the form of a share of the crops in place of a stated wage. Although the conditions hardly seem to justify this contention, it is interesting to note what would be the result of a reclassification in which croppers were considered simply as hired hands. The percentage of tenancy in the South in 1920, including the croppers, was 49.6; excluding the croppers both from the number of tenants and from the total number of farmers, the percentage would be 38.9. In the state of Georgia, which in 1920 showed the highest percentage of tenancy among all the states in the United States, the percentage would be reduced from 66.6 to 51.3 if the croppers were excluded. Even with the croppers excluded, however, several other southern states in addition to Georgia would still have higher percentages of tenancy than any of the northern states, among which Nebraska, with 42.9 per cent, and Illinois, with 42.7 per cent, show the highest proportion of tenants.

### FARM VALUES

The value of all farm property in 1920 was $77,924,100,338, as compared with $40,991,449,090 in 1910. This represents an increase of $36,932,651,248, or 90.1 per cent, during the decade. The absolute increase, nearly $37,000,000,000, is certainty big enough to warrant careful consideration, even in these days when values are frequently counted in billions. On a relative basis, however, the increase of 90.1 per cent is less than the increase between 1900 and 1910, which amounted to 100.5 per cent, and considerably less than the increase in the general price level between 1910 and 1920, which was 146 per cent, according to the wholesale price index of the Bureau of Labor.

The increase in farm real estate values, of course, is the principal factor in the increase in the value of all farm property. The value of farm land and buildings in the United States increased 109.5 per cent between 1900 and 1910, and 90.6 per cent between 1910 and 1920. Taking the figures for the average value per acre, in order to eliminate the effect of any increase in farm acreage, it appears that the average value of farm land and buildings per acre of land increased from $19.81 in 1900 to $39.60 in 1910, or 100.2 per cent, and again to $69.38 in 1920, an advance of 75.1 per cent over the value in 1910.

The fact that the average value of farms per acre in the country as a whole increased only 75.1 per cent in the 10 years ending with 1920, as compared with an increase of 100.2 per cent in the 10 years ending with 1910, is especially significant in view of the fact that the general price level increased to a much greater extent between 1910 and 1920 than it did during the preceding decade. Further, the increases shown in the 1920 figures for several of the corn belt states (forming a material part of the increase in the United States as a whole) may be attributed in part to the wave of speculation which swept over that part of the country during 1918 and 1919. The states showing especially high percentage increases in the value of land per acre also include a number of cotton states. And both in the corn belt and in the cotton states the present low prices of farm products have already brought about great reductions in real estate values.

Taking all the circumstances into consideration, then, the figures which by themselves appear to represent such a great increase in farm values in 1920 really indicate a halting in the upward tendency which these values have shown since 1850.

Theoretically, the value of the farm land in any country increases in proportion to the number of inhabitants to be supported per 1,000 acres of cultivated land. As a matter of statistical record, however, the number of inhabitants in the United States per 1,000 acres of improved land shows only a slight net increase since 1850. In 1850, when the average value of farms per acre was $11.14, there were 205 inhabitants per 1,000 acres of improved land in farms; in 1910, when the average value of farms per acre was $39.60, there were 192 inhabitants per 1,000 acres of improved land, or actually fewer than in 1850; and in 1920, with farms valued at $69.38 per acre, there were only 210 persons per 1,000 acres of improved farm land. The theory, then, has not worked out in the experience of this country up to the present time.

The expectation of a continuous increase in the value of farm land has come to be a fixture in the minds of American farmers, and in many sections it is a fundamental part of the prevailing scheme of farm economics. If the farm income above the amount equivalent to fair wages for the farmer is considered as interest on the farm investment, it seldom amounts to more than 3 per cent. The average annual increase in the value of the farm for the past 20 or 30 years, however, in many parts of the country has been 6 or 7 per cent. The 3 per cent of actual operating income plus the 6 or 7 per cent of increase in value has made up a fairly satisfactory total income on the investment.

It has been evident to many economists studying the problems of farm economics that this increase in the value of farm land could not go on forever. The increases since 1900 have been assisted by a rapid increase in the general price level; in fact, the increase since 1910 has not kept pace with the increase in the general price level. Looking forward, then, as we probably must, to a long period of declining prices, how can we expect the value of farm land to go on increasing?

The farm whose operating income now pays 3 per cent on its purchase (or market) price will have no other source of income by way of supplement. In fact, if the market value of the land declines, the decrease in the selling value of the farm from year to year may even exceed the net operating income. What effect will this have on the rental charged for the use of farms operated by tenants? Such farms constitute a considerable percentage of the total number of farms, both in the South and in the Middle West. The rentals charged now are high enough to make it fairly difficult for the tenant farmer to obtain a satisfactory income. Suppose they were to be suddenly doubled in order to make up for the lack of any further speculative profit from the rise in land values. What would then become of the tenants?

And what are the prospects of the farm owner who has profited greatly during recent years, whether he has realized it or not, from the speculative increase in the value of his land holdings? These are serious questions —questions for the agricultural economist, however, rather than for the statistician. Nevertheless I will venture one suggestion—that the solution of the problem will come chiefly through increased efficiency in the conduct of farming operations.

## MORTGAGED FARMS

The census figures relating to farm mortgages are limited to those farms which are operated by their owners, no attempt being made to secure mortgage data for farms operated by tenants or managers. The reason for this restriction is that the tenant or manager in very many cases would not know whether the farm was mortgaged or not, and he would be even less likely to know the amount of the mortgage debt.

The total number of farms operated by their owners in the United States in 1920 was 3,925,090. Of these farms 1,461,306, or 37.2 per cent, were reported as mortgaged, as compared with 33.2 per cent in 1910.

The figures representing the amount of the mortgage debt relate only to the farms operated by farmers owning all the land which they operate. This limitation is made necessary by the difficulty of ascertaining the value of that part of the farm covered by the mortgage in cases in which the farmer owned a part of the farm and hired a part of it.

The amount of the farm mortgage debt reported was $4,003,767,192 in 1920, as against $1,726,172,851 in 1910. The increase in the amount of debt was $2,277,594,341, or 131.9 per cent, while the value of the mortgaged farms increased only 117.6 per cent during the same period.

The value of the farms for which the amount of mortgage debt was reported in 1920 was $13,775,500,013. The debt therefore represented 29.1 per cent of the value, as compared with 27.3 per cent in 1910.

The average rate of interest paid on farm mortgages in 1919 was 6.1 per cent. This item has not been secured in any previous census except that for 1890. The rate then, obtained in a different way but approximately comparable, was 7.07 per cent.

The increase in the number of mortgaged farms or in the amount of mortgage debt does not necessarily indicate any lack of prosperity, since the money is borrowed in many instances for profitable investment in improvements or in the purchase of additional land. A large part of the total doubtless represents the balance due on the purchase price from recent purchasers who paid a part of the price of the farm and gave a mortgage for the rest. Aside from this item, however, the increase in the mortgage debt presents one aspect radically different from the increase in the value of any class of farm property. The value of the farm may double in a decade without making any very material change in the routine of the farm business. That is, the increase may be simply on paper, so to speak. The increase in the mortgage debt, however, aside from the item just referred to, means that the farmers have received and spent for some purpose actual money to the amount of the increase. Since the amount of the increase in the farm mortgage debt on owned farms alone between 1910 and 1920 was more than $2,000,000,000 one may well ask what the farmers did with the money.

### MOTOR VEHICLES, TELEPHONES, WATER, AND LIGHT

Among the new inquiries on the 1920 farm schedule, one that has aroused a great deal of interest relates to the number of farms having motor vehicles, telephones, water, and gas or electric light. According to the returns, 30.7 per cent of all farms in the United States in 1920 had an automobile. Some farms, of course, had more than one, but the significant figure is the number of farms which had at least one. Two per cent of all the farms had a motor truck, and 3.6 per cent a tractor. A telephone was reported by 38.7 per cent of the farms, water piped into the house by 10 per cent, and gas or electric light by 7 per cent.

### VALUE OF LIVE STOCK

The value of all live stock on farms on January 1, 1920, was $8,013,324,808, as compared with $4,925,173,610 on April 15, 1910. The value of the live stock thus shows an increase of 62.7 per cent, which is a smaller relative increase than that shown by any of the other classes of farm property—either land and buildings or implements and machinery. The value of horses, the most important of the domestic animals in point of value in 1910, shows an actual decrease of $301,510,708, or 14.5 per cent.

The average value of horses per head decreased from $105.06 in 1910 to $90.15 in 1920, and the average value of mules increased only from $124.80 to $143.45. In contrast with the decrease in the average value of horses and the slight increase in the value of mules, the several kinds of meat animals (cattle, sheep, and hogs) show average values for 1920 more than double those of 1910.

### HORSES AND MULES

The number of horses on farms reported for January 1, 1920, was 19,767,161. The number of horses reported for April 15, 1910, was 19,833,113 including 612,775 spring colts. If we compare the numbers as reported, the 1920 figures show a decrease of 65,952, or 0.3 per cent. If we deduct the spring colts from the 1910 figures, on the ground that they could not have been counted on the first of January, since they were not then in existence, the figures show an increase of 546,823, or 2.8 per cent. The actual increase was somewhat less than this, however; for the number of mature horses (or horses and yearling colts) would be smaller in April than in January, since some would have died during the intervening months. These would offset, in part, the number of spring colts born between January and April.

The number of mules on farms on January 1, 1920, was 5,432,391, as compared with 4,209,769 on April 15, 1910. Making the comparisons in the same way as for the horses, the minimum increase in the number of mules was 1,222,622, or 29 per cent, and the maximum increase was 32.5 per cent. Between these two figures—perhaps about half-way between—lies the actual increase.

## CATTLE

The number of cattle on farms in the United States on January 1, 1920, was 66,652,559, while the number on April 15, 1910, was 61,803,866, including 7,806,539 spring calves, which would not have been reported, of course, if the 1910 census had been taken in January. On the other hand, a census taken in January would have included the large number of cattle which were marketed or slaughtered during the first three and one-half months of the year. The two factors affecting the comparability of the figures for 1910 and 1920 are about the same, then, as with the horses and mules, except that the margin between them is much greater. The total number of cattle reported for 1920 exceeds the total number for 1910 by 4,848,693, or 7.8 per cent. The total number of cattle reported for 1920 exceeds the number in 1910, omitting the spring calves, by 12,655,232, or 23.4 per cent. The minimum percentage of increase is 7.8, and the maximum is 23.4. The actual increase is less than the maximum by the number of cattle slaughtered or marketed by farmers between January 1 and April 15, 1910.

The change in the date of enumeration probably affected the number of dairy cows much less than it did the number of all cattle, but there was also a change in the age classification. Dairy cows in 1910 included all cows and heifers over 1 year of age on January 1 of the census year, while dairy cows in 1920 included only those cows 2 years old and over on January 1 of the census year. The number of dairy cows 2 years old and over reported for 1920 was 19,675,297, and the number of dairy heifers 1 year old and under 2 years was 4,048,851. There were thus 23,724,148 dairy cows and heifers 1 year old and over, as compared with 20,625,432 in 1910. This gives an increase of 3,098,716, or 15 per cent. In considering the absolute increase, however, it should be remembered that this includes yearling heifers. The increase in dairy cows 2 years old and over would be about 2,550,000.

### PURE-BRED LIVE STOCK

Pure-bred live stock of some kind (either horses, cattle, sheep, or swine) was reported in 1920 by 693,724 farms, or 10.8 per cent of the total number in the United States in 1920. Of the total number of horses on farms, 0.6 per cent were reported as pure bred; of the cattle, 3 per cent; of the sheep, 1.3 per cent; and of the swine, 3.5 per cent.

### DAIRY PRODUCTS

The value of dairy products of farms in 1919, including butter and cheese made and milk, cream, and butter fat sold, was $1,481,462,091, as compared with $596,413,463 in 1909, thus showing an increase of 148.4 per cent. A large part of this increase, of course, was the result of higher prices; but after making allowance for an increase of 115 per cent in the prices of dairy products, there still remains an increase of 15.5 per cent in the production.

The quantity of milk produced in 1919, including estimates for farms which reported dairy cows on hand but failed to report their milk production, was 7,805,143,792 gallons, which represents an increase of about 18 per cent over the production of 1909.

The production of butter on farms in 1919 was 707,666,492 pounds, as compared with 994,650,610 pounds in 1909. The decrease (amounting to 28.9 per cent) in the farm production of butter was more than made up, however, by an increase in the factory production. Incidentally, the 1919 figures indicate that the movement of butter production to the factories and away from the farms is still making rapid progress. In 1899 only 28.2 per cent of the total production of butter was made in factories; in 1909, 38.6 per cent; and in 1919, 56.5 per cent, or considerably more than one half. And if only that butter which is produced for sale is considered—taking the amount of butter *sold* by farmers, in place of the total quantity *made* on farms—it appears that 81.6 per cent of the commercial production of butter in 1919 was made in factories and only 18.4 per cent on farms.

### CROPS IN GENERAL

The total value of farm crops harvested in 1919 (not including forest products) was $14,755,364,894, as compared with $5,231,850,683 in 1909. These figures represent an increase of $9,523,514,211, or 182 per cent, for the decade. In other words, the value of all farm crops in 1919 was nearly three times the value in 1909. This enormous increase in the value of crops is due mainly, however, to the fact that the prices of crops were unusually high in the year 1919. A tabulation of the quantities of all the important crops harvested in 1919 with values computed on the basis of the 1909 prices indicates an increase of only 9 per cent. So much of the increase in value, therefore, may be attributed to increased production, and the remainder to higher prices.

The index of the census prices of all farm crops in 1919, taking the values of 1909 as 100, is 257, and the index for crops and live-stock products together is 248. The latter index is only a little higher than the Bureau of Labor's index of wholesale prices of farm products which, as computed for the same years, was 241.

The total acreage of all crops harvested in 1919 for which acreage was reported was 348,551,669, as compared with 311,194,516 acres in 1909, representing an increase of 12 per cent.

## PRINCIPAL CROPS

The acreage of corn harvested in 1919 (not including silage or corn cut green for fodder) was 87,771,600, as compared with 98,382,665 in 1909. The acreage of wheat on the other hand increased from 44,262,592 in 1909 to 73,099,421 in 1919. There was thus a decrease of 10,611,065 in the acreage of corn and an increase of 28,836,829 in the acreage of wheat. To a considerable extent, without doubt, the increase in the wheat acreage was the result of a temporary condition, namely, the guaranteed price for wheat for the crop of 1919; and under present conditions several million acres of this land are doubtless again used for raising corn.

The production of corn in 1919 was 2,345,832,507 bushels; of wheat, 945,403,215 bushels; and of oats, 1,055,182,798 bushels. These three crops constitute the bulk of our cereal production.

The production of hay and forage in 1919, not including 17,793,742 tons of corn cut for forage, was 128,549,499 tons, as compared with 97,755,296 tons in 1909, an increase of 12.8 per cent. The production of silage crops in 1919 was reported by 378,887 farms, or 5.9 per cent of all farms in the United States. The acreage in silage crops was 4,003,226 and the production 29,682,041 tons, which was more than three times the production in 1909.

The production of tobacco increased from 1,055,764,806 pounds in 1909 to 1,372,993,261 pounds in 1919, or 30 per cent, and the production of cotton increased from 10,649,268 bales to 11,376,130 bales, or 6.8 per cent.

## SUMMARY

By way of summary three or four outstanding features in the results of the farm census of 1920 may be mentioned. There have been considerable increases in the number of farms and in farm acreage in the West and the Northwest, partly offset by decreases in the eastern states.

The increase in farm values between 1910 and 1920, although very great in absolute amount, represented a smaller percentage for the decade than did the increase between 1900 and 1910. This fact, taken in connection with the enormous increase in the general price level during the past decade and other existing conditions, is believed to indicate that the value of farm property reached a peak in 1920 and that further increases should not be expected in the immediate future. The farm mortgage debt, as measured by the debt on farms operated by their owners, considerably more than doubled between 1910 and 1920. Crops and live-stock products showed some increase in quantity during the ten years ending with 1919, but the large increases in value were due mainly to increased prices.

## DISCUSSION[1]

By C L. Stewart

There is danger that the country may be lulled to indifference by reports that the rate of increase of farm tenancy in the United States is rapidly diminishing. It is true that the number of tenant farms per thousand grew from 353 in 1900 to 370 in 1910, an increase of 5 per cent, whereas from 1910 to 1920 the number grew from 370 to 381, an increase of only 3 per cent. When measured on the basis of acreage and value, however, the number of rented acres per thousand and the number of dollars worth of rented land per thousand was not only higher than that shown on the preceding basis, but has been growing at much faster rates during both of the decades since 1900, especially during the decade just ended. While the proportion of rented farms increased but 3 per cent between 1910 and 1920, the proportion of leased property values and of leased acreage increased 11 per cent.

In other words, the tenure of American farm real estate cannot be correctly stated in terms of farms only. In most sections farms operated by tenants differ in size and value from farms of other operators. Furthermore, parts of farms are hired by so-called "part-owners." These can properly be accounted for as operators of tenant realty only in statistics of acreage and value.

In 1920 part-owner tenancy involved 89 million acres and nearly 4 billion dollars worth of land and buildings. At the same date "full" tenancy claimed 265 million acres and nearly 24 billion dollars worth of land and buildings. Altogether 354 million acres and nearly 28 billion dollars worth of land and buildings were operated by lessees.

To reduce the lessee acreage and values to percentages of all farm acreage and values, the 54 million acres and nearly 3 billion dollars worth of property in farms operated by managers may be either included or excluded. The employers of managers do not in all cases own all the land and buildings they commit to the custody of their representatives, but they can be classified as owners, part-owners, and tenants, as are operators of farms under more direct operation. Since our statistics of tenure bear only on directly operated real estate, for some purposes it is desirable to express the lessee percentages for non-manager property only, even though the result is to reduce the showing of operating owners and increase that of lessees.

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[1] Also read at the Pittsburgh meeting.

Without excluding property in farms operated by managers, the percentage of acreage operated by lessees in 1920 was 37, and the lessee percentage of land and buildings as measured by value was 42. Omitting real estate operated by managers, lessees operated 39 per cent of the farm land as measured by acreage and 44 per cent of the total valuation of farm land and buildings. On this basis lessees in 1920 operated 44 per cent of the improved acreage and 46 per cent of the value of land alone.

Since the proportion of agricultural property operated under lease falls short of the half-way mark by such a narrow margin for the United States as a whole, it is not surprising to find that in some areas the half-way mark has been passed. Without excluding property in farms of managers, over half the acreage of all land was leased in 2 states, Delaware and Illinois, both in 1910 and in 1920, with a tendency toward increase in Illinois. If improved land alone is considered, 10 more states must be added—Alabama, Georgia, Iowa, Kansas, Mississippi, Oklahoma, South Carolina, South Dakota, Texas, and Washington. Of our farm land and buildings, as measured by value, 4 states show percentages above fifty. These are Illinois, Oklahoma, Mississippi, and South Dakota. When farm buildings are left out of account, the states of Delaware, Georgia, Iowa, Kansas, Nebraska, and South Carolina must be added to the list.

The number of states that had passed the half-way tenancy mark with respect to improved acreage was 5 in 1900, 8 in 1910, and 12 in 1920. The number that had passed the same mark with respect to land valuations was 2 in 1900, 5 in 1910, and 10 in 1920.

The highest percentage shown by any state on the basis of improved acreage in 1920 was Georgia with 59.8, and on the basis of land valuations, Illinois with 60.3.

It appears that lessee farming has become characteristic of vast areas not only in the cotton and corn belts but even in the Pacific Northwest. How vast these areas are may be understood by the following comparisons. The tenants of the United States operate an area of unimproved land larger than the entire surface of France or Germany, and almost as large as Texas. They operate an improved acreage six times the area of Illinois, or Arkansas, or Iowa. The value of the farm property they operate exceeds the direct cost to the United States of the World War. If the Federal Farm Loan system is to be an important aid to tenants in financing the purchase of the land now rented, it is clear that it must operate in terms, not of millions, but of billions. If all instead of 5 per cent of the half billion made available to borrowers through the Federal Land banks and joint stock land banks in the last five years had been used to finance tenant purchases of farms, it would have met the first mortgage need on less than 5 per cent of the land now operated by tenants.

Decreases in the proportion of improved acreage operated under lease took place in 15 states between 1900 and 1920. These were found mainly east of the Appalachians and in the southeastern section. The states showing the most marked increases in the proportions of improved acreage rented were those of the northwest quarter of the United States.

When tenancy changes of the last two decades are put in terms of land valuations, it appears that the states of the Central West have also taken part in the movement toward increase. The renting of the more valuable lands, particularly within the corn belt, coupled with a somewhat increased operation by owners in the case of cheaper lands, appears to have been an important tendency in the Mississippi Valley regions.

In other words, the changes in the relative prominence of lessee agriculture in the United States have more marked significance when measured on the three bases, acreage, valuation, and number of farms, than when measured on the basis of number of farms alone. The relative amount of the changes indicated is not the least of the reasons for this. As against an increase of 7.9 per cent in the number of tenant farms per ten thousand for the two decades, there was an increase in the number of rented acres per thousand amounting to 20.9 per cent, and in the number of rented dollars worth of land and buildings per ten thousand amounting to 24.2 per cent. The rate of increase of tenancy is shown in percentages from twice to four times as large when expressed on the basis of acreage and valuation.

Comparing the two decades, 1900–10 with 1910–20, it appears that the number of tenant farms per ten thousand increased by 171 in the earlier period and by only 107 in the later period. Owing to the marked increase in acreage of unimproved land operated by lessees between

1910 and 1920, however, that decade showed a larger increase of leased acres per ten thousand than the preceding decade by nearly a third. In like manner, the number of dollars worth of land and buildings rented per ten thousand increased over twice as much in the decade just closing.

In the light of this analysis, the tide of tenancy is shown by the latest census to have continued its upward flow with little or no abatement.

# REPORT ON AN ANTHROPOMETRIC INVESTIGATION OF THE POPULATION OF THE UNITED STATES

By Franz Boas, *Columbia University*

## CHARACTERISTICS OF THE POPULATION OF THE UNITED STATES

The white population of the United States differs from that of Europe not so much in character as in the mode of assemblage of its component elements. The important theoretical and practical problems that arise in a study of the biological characteristics of our population relate largely to the effects of the recent rapid migrations of the diverse types of Europeans. The problem is further complicated by the presence of a large negro population, of small remnants of Indian aborigines, and by a slight influx of Asiatics.

It would be an error to assume that the intermingling of different European types is a unique historical phenomenon which has never occurred before. On the contrary, all European nationalities are highly complex in origin. Even those most secluded and receiving the least amount of foreign blood at the present time have in past times been under entirely different conditions. An excellent example of this kind is presented by Spain. The Iberians are the earliest substratum of population with which we are acquainted. The coast population was undoubtedly affected by a certain amount of intermixture with Phoenician and Greek colonists. There followed a number of migrations of Celtic tribes from northwestern Europe and a thorough colonization of the peninsula by Rome. The Teutonic tribes which invaded Spain came in part from the regions of the Black Sea. Later on we can trace waves of migration from northern Africa, which attained their greatest importance during the time of the Moorish empires. With the development of medieval conditions and the expulsion of the Moors and the Jews, the population of Spain became stable and there was no further disturbance due to important migrations. It is therefore evident that the present population of Spain contains elements derived from practically all parts of Europe and from northern Africa.

Similar conditions may be observed in Great Britain, where there is also clear evidence of a large number of waves of migration. In prehistoric times we find a long-headed type, quite different in appearance and in customs from a later round-headed type. With the beginning of historic times we observe first Roman colonization, then waves of migration entering Great Britain from all parts of the North Sea, from Scandinavia and northern Germany, and, finally, the influx of the Normans. With this event extended migration ceased and the population of the island was gradually welded into the modern English.

Migrations of this kind may be recognized even in very early times. After sweeping over the older population of Greece, north European types established themselves in the Balkan Peninsula and on the Aegean islands during the so-called Doric migration, which occurred a thousand years before our era. Later on the movements of the Finnish ancestors of the Bulgarians and the migrations of the south Slavic peoples added to the intermixture of types in the eastern European peninsula.

It might seem that a few countries in Europe were not so much exposed to intermixture as those previously mentioned, and it is particularly assumed that Sweden and Norway represent a very homogeneous population. Still, we may recognize here also a considerable differentiation of local types. An investigation of the districts nearest to Finland shows very clearly an approach to the Finnish type which may be due to intermixture. In southern Norway is encountered a strongly aberrant type whose origin cannot be historically determined. In the northern area the Lapps present a foreign element. In later times immigrations were not by any means rare. Thus the development of the mining industry brought in a great many Walloons; and the nobility, at least, is a composite of descendants of natives from many parts of Europe. Historical evidence shows that the central parts of Europe over which migrations have swept periodically were, even more than the outlying districts, exposed to intermixture of different types.

Intermixture in Europe was largely confined to antiquity although in some parts it continued into the Middle Ages, whereas the intermingling of different local types in the United States is recent. Owing to the social conditions in ancient Europe amalgamation of distinct elements may have been rather slow. Notwithstanding the relatively small numbers of migrating individuals, it may have taken several generations for the intrusive and native populations to become merged. In the United States, owing to the absence of hereditary social classes, the amalgamation is on the whole more rapid and involves larger numbers of individuals than the intermixture which took place in earlier periods in the Old World.

The impression that the population of European countries is comparatively speaking "pure" in descent is founded on its stability. In northern and central Europe this condition developed after individual hereditary landholding was substituted for the earlier forms of agricultural life, and with the attachment of the serf to the soil which he inhabited. These conditions prevailed in the Mediterranean area even in antiquity, but in the northern parts of Europe they did not develop until the Middle Ages, when the more or less tribal organization of the people gave way to feudal states. During the period when the Celtic and Teutonic tribes moved readily from place to place a vast amount of mixture occurred in all parts of Europe. Later on, when families became settled, those parts of the populations which were proprietors of the soil, or otherwise attached to the soil, became stationary, and consequently intermixture between distant parts of the continent became very much less frequent than in previous times. On the other hand, the mutual permeation of neighboring communities probably became much more thorough.

These conditions of stability continued until by the development of cities diverse elements were brought together in the same community. This process became important with the growth of modern industrialism and with the concomitant growth of urban populations that were drawn together from large areas. Investigations made in different parts of Europe, particularly in Italy[1] and in Baden,[2] show differences in type between city populations and those of the open country. These may in part be explained by the strong intermixture of types drawn from a wide area which assemble and intermarry in the city. Observations of the population of Paris[3] indicate the same kind of intermixture of north European and central European types.

The settlement of the unoccupied districts of the United States has brought about an intermixture of types similar to that occurring in modern city populations, because settlers from different parts of Europe may dwell in close proximity in newly opened countries. Although in many cases we find a strong cohesion of farmers who come from the same European country, there is also a great deal of scattering.

It should, therefore, be understood that the problems presented by the population of the United States do not differ materially from the analogous European problems. The differences are due to the larger numbers of individuals involved in the whole process, in its rapidity, in its extension over rural communities, and in the forms of cohesion between members of the same group which are dependent upon the mode of settlement of the country. The process resembles earlier European mixtures in so far as many diverse European types are involved. In modern Europe only European types enter into the mixture, but a number of races morphologically removed from the white race enter into certain phases of the problem in America. Even this aspect of the problem was probably present in antiquity when slaves of foreign races formed a considerable part of the population.

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[1] Ridolfo Livi, *Antropometria Militare*, p. 87 *et seq.*

[2] Otto Ammon, *Zur Anthropologie der Badener*, p. 641.

[3] Franz Boas, "The Cephalic Index," *American Anthropologist*, N. S. vol. 1, p. 453.

The long continued stability of European populations which set in with the beginning of the Middle Ages and continued, at least in rural districts, until very recent times, has brought about a large amount of inbreeding in every limited district. In default of detailed statistical information in relation to the development of populations it is impossible to give exact data, but a cursory investigation shows that inbreeding of this type must have occurred for a very long time. The theoretical number of ancestors of every living individual proceeds by multiplication by two from generation to generation back, so that ten generations (or approximately 300 or 350 years) ago every single individual would have had 1,024 ancestors. Therefore, about 600 or 700 years ago there would be more than 1,000,000 ancestors for each individual. Considering the stability of population, such an increase in the number of ancestors is, of course, entirely impossible, and it necessarily follows that a very large number of individuals in the ancestral series must be identical, which means that there must have been a large amount of inbreeding.

The "loss of ancestors" becomes the greater the farther back we go in the ancestry and the more stable the population. It is obvious that particularly in the landholding group of families which remains from generation to generation in the same place, there must have been much inbreeding. Statistical information is available only for a few village communities and for the high nobility of Europe. The genealogies of all these families demonstrate that the decrease in the number of ancestors is very considerable. The calculations for the high nobility of Europe[1] show that in the sixth ancestral generation there are only 41 ancestors instead of 64; in the twelfth generation, only 533 instead of 4,094. These numbers seem to be quite similar to those found in the stable village communities of Europe. Owing to this intermixture and to the similarity of descent of the families constituting the population, each family represents fairly adequately the whole population, or as we might express it, the whole population is homogeneous, in so far as all the families have the same kind of descent. On the other hand, in a population that results from recent migration and in which individuals from the most diverse parts of the world come together, a single family will not be representative of the whole population, because entirely different ancestral lines will be present in the various families. Therefore the population will be heterogeneous in so far as the different families belong to different lines of descent. To illustrate this point we might assume a community consisting of whites and negroes in which the whites always intermarry among themselves, and the negroes among themselves. Obviously in such a population a single family would not be representative of the whole community, but only of its own fraction. On the other hand, if we had a community in which whites and negroes had intermarried for a long time, as is the case among the so-called Bastards of South Africa—a people very largely descended from Dutch and Hottentots and in which this intermingling has continued for a long time—we have a homogeneous population in so far as every family represents practically the same line of descent.[1] It will therefore be seen that homogeneity is not by any means identical with purity of race. In the case of a homogeneous population of mixed descent we may expect, on the whole, a high degree of variability in the family, while all the families will be more or less alike. On the other hand, in a heterogeneous population in which each part is comparatively speaking "pure," we may expect a low variability of each family with a high variability of the families constituting the whole population. On account of its migratory habits the American city population must be heterogeneous. Heterogeneous are also the immigrants and their immediate descendants, whereas in the stationary populations of New England villages and of the Kentucky mountains we have presumably homogeneous groups.

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[1] Ottokar Lorenz, *Lehrbuch der gesamten wissenschaftlichen Genealogie*, Berlin, 1898, p. 289 *et seq.*, pp. 308, 310, 311.

## HEREDITY

In determining the characteristics of a population knowledge of the laws of heredity is indispensable. Ordinarily the term heredity in relation to racial characteristics is used in a somewhat loose manner, and we should distinguish clearly between the hereditary stability of a race and the hereditary characteristics which determine the bodily form and functions of an individual. The concept of hereditary stability in a race can mean only that the distribution of forms which occur in a population in one generation will be repeated in exactly the same way in the following generation. This is clearest in the case of a homogeneous population as defined before. In every population varying bodily forms of individuals will occur with characteristic frequencies. In an undisturbed homogeneous population we must necessarily assume that each generation will show the same characteristic distribution of individual forms. If it did not do so there would be a disturbance of the hereditary stability.

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[1] Eugen Fischer, *Die Rehobother Bastards*, Jena, 1913. Franz Boas, "On the Variety of Lines of Descent Represented in a Population," *American Anthropologist*, N. S., Vol. 18, p. 1 *et seq.*

Conditions are quite different in a heterogeneous population like that of the United States. Owing to intermarriages between the various constituent types there must be a tendency toward greater homogeneity, setting aside, of course, the influx of new immigrants. Experience shows that no matter how rigid may be the social objection to intermarriages between different groups, or how strong the pressure to bring about marriages between members of the same group, they will not prevent the gradual assimilation of the population. An instance of this kind is presented by the castes of India in Bengal. Notwithstanding the rigid endogamy of castes it has been observed that the highest castes are similar in type to the peoples of Western Asia, while the lower down in the scale of castes we go the more this type becomes mixed with the older substratum of the native population.[1] This can be explained only by intermarriage between the different castes which must have occurred notwithstanding the rigid laws forbidding it. The less the tendency toward segregation of different groups, the more rapid will be the approach toward homogeneity. Therefore notwithstanding the laws of hereditary stability in individual strains, there cannot be a hereditary stability of a heterogeneous population until homogeneity has been attained. It may even be considered doubtful whether a disturbance of the distribution of bodily forms may not occur as an effect of the intermingling of two populations similar or even identical in type, but of different ancestry, in which, therefore, a heterogeneity of ancestry exists.[2]

Thus it will be seen that the physiological laws of heredity are quite different from the statistical expression of the effects of heredity upon a large population. The latter depends upon both the biological laws of heredity and the peculiar social structure of the population which is being considered. These two aspects of heredity must be kept clearly apart.

Unfortunately, the laws of heredity in man are not clearly known, and it is not yet possible without overstepping the bounds of sound, critical, scientific method to apply them to the study of the characteristics of a population. A considerable amount of preliminary fundamental work must be done before we can proceed to the explanation of special complex phenomena. One fundamental point of view may be considered as established, namely, that when a definite couple of parents is given, the probability of occurrence of a given form among the descendants of this couple is fixed. In man it is not easy to demonstrate this fact because the number of children for each couple is small. If we assume, however, an organism in which each parental couple has an infinitely large number of offspring, the laws of heredity may be so expressed that each form that occurs among the offspring has a definite probability. In man these laws can be investigated only by combining many families in which both parents, or at least one of the parents, has the same characteristic form, although in this case the phenomenon is obscured by the fact that the same form in the parent does not necessarily mean the same ancestry.[1] Observation of various features of the body of man show that the simple forms of Mendelian heredity are not often applicable. It is true that in a number of cases of pathological modifications, the validity of the simple Mendelian formulas has been established. Even in these cases the number of observations is not sufficient to determine whether we are dealing with exact Mendelian ratios or with approximations. Practically all other cases are still open to doubt. Even in the case of eye color, which has been claimed to be subject to a simple Mendelian ratio with dominance of brown over blue, the available figures are not quite convincing.[2] For the more complex variable measurements of the body simple Mendelian ratios are certainly not applicable. Up to the present time the complex laws governing the frequencies of occurrence of bodily forms among descendants of an ancestral line are not known.

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[1] H. H. Risley and E. A. Gait, *Census of India, 1901*, Calcutta, 1903, Vol. 1, p. 489 *et seq.*

[2] M. D. and Raymond Pearl, "On the Relation of Race Crossing to the Sex Ratio," *Biological Bulletin*, Vol. 15, 1908, p. 194 *et seq.*

The investigation of any population must, therefore, take into consideration the detailed study of the laws of heredity.

## THE INFLUENCE OF ENVIRONMENT

In settling in the United States the immigrants have been brought into a new environment, geographically as well as socially, and the question arises whether the new environment exerts an influence upon bodily form and functions. It has been customary to consider certain features of bodily development as absolutely stable, and anthropologists have characterized modern human types as "permanent forms" which have lasted without variation from the beginning of our modern geological period up to the present time. It is fairly easy to show that in this view exaggerated importance is ascribed to the phenomena of observed hereditary stability.

We know that the bulk of the body of an adult depends to a certain extent upon the more or less favorable conditions under which the child grows up. It has been shown that malnutrition or pathological conditions of various kinds may retard growth, and that the retardation may be so considerable that it cannot be made up by long continued growth. As a matter of fact, the bulk of the body at the time of birth is so small as compared to the bulk of body of the adult that it is easy to understand that environmental conditions must exert a considerable influence upon its development. Proof of this is the gradual increase of stature during the past fifty years, until 1914, which has been demonstrated by investigations in a number of countries in Europe, and the difference in stature which is found in the same nationality for people living under different economic conditions.[1]

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[1] Boas, "On the Variety of Lines of Descent Represented in a Population," *loc. cit.*

[2] Helene M. Boas, "Inheritance of Eye Color in Man," *American Journal of Physical Anthropology*, Vol. 2, p. 15 *et seq.*

Since many proportions of the body are related to stature and bulk, these will also undergo modifications due to environmental conditions. The influence of environmental conditions is not so obvious in those cases in which the bodily form is practically determined at the time of birth, or in those in which the total growth from the time of birth until the adult stage is very slight. It might be assumed that in all cases of this type heredity alone determines the characteristic form of the body.

From a wider point of view the assumption that environment has no influence upon the form of the body does not seem justified. It must be understood that the question of stability or instability of the body in relation to environmental influences has no relation to the question of the inheritance of acquired characteristics. Even if we should adhere most rigidly to the dogma of the impossibility of the transmission of acquired characteristics, we must admit that a modification of the bodily form of the individual is easily conceivable without the necessity of assuming any modification of the germ plasm owing to individually acquired variation. We should rather have to say that adaptability of a definite type is one of the hereditary characteristics of the germ plasm. The problem involved is readily understood in the case of plants which appear in strongly modified form according to the environment in which they grow. In many cases the amount of hairiness, the form of the leaves, etc., are subject to the degree of moisture of the soil, and an accurate description of the species would therefore involve a statement that the plant has a certain degree of hairiness, dependent as a definite function upon the moisture of the soil, or that the leaves have a certain form dependent upon outer circumstances. In other words, the plant has a definite form only under a definite environment, and with changing environment, the form changes.

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[1] Rudolf Martin, *Lehrbuch der Anthropologie*, 1914, p. 225.

We may include under the group of environmental effects also all those variants of form and function that are dependent upon social habits which influence the organism. An influence upon bodily form is exerted by the habitual uses to which groups of muscles are put. Thus the rest position of the lower jaw is different in different areas. The English seem to hold the lower jaw a little farther forward than the Americans. The people of the western states relax the soft palate more than those of the North Atlantic area. The facial expression is determined by the development of the groups of facial muscles; the variations of certain aspects of the form of the hand and the foot are of this kind. The functioning of organs is even more markedly dependent upon habits, particularly upon habits firmly established during childhood. This is illustrated by the characteristic gait of individuals and of whole groups of people; by the involuntary movements in response to certain stimuli; by many of the expressive movements of the body; by habits of articulation; and by the dexterity and accuracy of movements obtained by early training.

Since we recognize the influence of environment upon the form of body including such features as bulk of body, or muscular forms and the functioning of organs, it seems justifiable to define racial characteristics as we do those of a variable plant, namely, by stating that under definite environmental conditions the bodily form of a race and its functioning are such as we observe, without prejudging the question in how far modifications in form and function may result from changing environment. The actual problem, then, would be to determine whether and how far the traits of the body may be so influenced. We should also bear in mind that it is perfectly conceivable that there may be congenital modifications in forms which are nevertheless not hereditary.[1] Constitutional changes in the body of the mother may bring about modifications in prenatal growth which to the superficial observer might give the impression of hereditary changes. These considerations demonstrate that it is necessary to consider this problem in any thorough investigation of the characteristics of the American population.

## SELECTION

The question must be asked in how far selective agencies may determine the movements of the population, including immigration and emigration, the settlement of the western parts of the United States by the inhabitants of the eastern states, and the migration from country to city. Besides migration, the selective influences of mating, of mortality, and of fertility have to be taken into account. Of late years much stress has been laid upon the effect of selection upon the constitution of a population.

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[1] *Cf. infra* p. 198.

The effect of selection as determined by bodily form can be investigated to advantage only in a homogeneous population. When every family may be considered as representative of the whole population, and when all strata of society present the same physical characteristics, selective forces that are based on social stratification will not influence the selective results, because all social strata will be alike; and if it should be found that groups representing different bodily forms have different tendencies to migrate, or different rates of mortality or fertility, we might have an expression of the direct dependence of selection upon bodily form.

As a matter of fact, however, homogeneous populations do not exist anywhere in the world. A greater or less amount of heterogeneity has always been observed, and heterogeneity in our modern civilization, at least, is always connected with social stratification. In a heterogeneous population like that of the United States the difficulties in the way of determining a direct relation between selective influences and bodily form are almost insurmountable. If, for instance, descendants of a certain nationality are attracted to a particular area, as the Scandinavians to the northwest, the Hungarians to the mines of Pennsylvania, the Mexicans to the southern borderland of the United States, or the French Canadians to the New England states and northern New York, we must remember that each one of these social groups represents a certain physical type and that there will be, therefore, an apparent relation between selection and physical type which in reality is based on social factors.

Similar observations may be made with regard to selective mating. Since mating depends upon social contact, marriages will occur among the groups that associate together. Wherever nationalities cluster together, where denominational or racial considerations act as endogamic restrictions, there will be selective mating of similar types due to social heterogeneity. Besides this there may be a certain amount of selection that unites tall with tall or expresses the sexual attractiveness of other bodily features.

Social heterogeneity exerts an influence also upon the mortality and the fertility of different groups. The more recent immigrants are on the whole less well-to-do than the earlier immigrants and their descendants. We know that there is a relation between fertility and economic well-being and we find, therefore, that the number of children of the more recent immigrants is greater than that of the descendants of earlier immigrants, so that, setting aside the question of mortality, there would be a shifting in the distribution of the population in favor of later immigrants. Since the earlier immigrants represent the northwestern European type and the later immigrants the south and east European types, there will appear in this case also a selection according to bodily form, which is due not to the direct relation between physical characteristics and fertility, but rather to the fact that the one economic group is composed of one type, and the other economic group of another type. In many cases the relation between descent and social stratification is so complex that it easily escapes our notice, and for this reason we may observe phenomena of selection apparently related to bodily form but actually due to obscure social causes that are discovered with great difficulty only.

On the other hand it cannot be denied that in some cases at least there must be a direct relation between bodily form and physiological function on the one side and selective processes on the other. It is, for instance, quite obvious that in the settlement of the new western countries a certain bodily and mental vigor was necessary to enable a person to undertake the venture. It has often been pointed out, although it has never been proven empirically, that in this way there must have been a selection from the inhabitants of the New England villages who migrated westward and that the emigrants represented a physically superior type. Even though this conclusion is not based on observation it seems highly probable. To the same group of phenomena would belong the supposed greater susceptibility to certain forms of disease of slightly pigmented individuals, as compared with the greater power of resistance of brunette individuals. I am not by any means convinced that incontrovertible proof of this assumption has been given; but if it were true that the constitution of the blond is weakened by exposure to intense sunlight, there might be a selective influence of this kind when a people move from the cloudy temperate zones to the brilliant sunlight of more southern and more arid climes.

In considering the selective influences of environment it should be borne in mind that the human body is so constituted that all its organs can operate adequately under widely varying circumstances. Our lungs are able to supply the needs of our body under the air pressure that prevails at the level of the sea, and they operate adequately at an elevation of 20,000 feet where the air is highly rarefied. The heart can adjust itself to the variation in demands made upon it, either in sedentary life at the level of the sea, or in active life in high altitudes. Our digestive organs may adapt themselves to a purely vegetable diet or again to a purely meat diet. Our central nervous system is also capable of adjusting itself to the most varied conditions of life. As long, therefore, as the conditions of environment do not exceed very elastic limits, it is not probable that selective influences would become operative to any very great extent, at least not in so far as they are determined solely by the form and functioning of the organs of the body.

### RACIAL AND INDIVIDUAL DIFFERENCES

An investigation of the bodily forms of the individuals constituting a race, homogeneous or heterogeneous, shows that they differ considerably among themselves, in every single feature, such as pigmentation, form of hair, size and proportions of the body, physiological reactions. These differences are measurable and express the degree of variability of the race. A complete presentation of the characteristics of a race would contain a statement of the relative frequency of each particular bodily form which occurs among the individuals constituting the race. When comparing, from the point of view of anatomical or physiological characteristics, the racial types of Europe which constitute the bulk of the American population, it appears that the range of variation for the different types is of such a character that a great many individuals belonging to one type correspond to other individuals belonging to another type. In other words, there are certain forms common to all populations of Europe. To give an example: We find strongly contrasting head forms in northern Italy and in Sardinia. Nevertheless an investigation of the distribution of head forms in each one of these districts shows that 27 per cent of the population may belong either to Sardinia or to northern Italy. In other words, there is a very considerable amount of overlapping of bodily form between neighboring types, and it is only when we consider races that are fundamentally different that we find certain characteristics that do not overlap. Comparing, for instance, the blond north European white and the dark Sudanese negro, there is no overlapping with regard to pigmentation, form of hair, form of nose, form of lips, etc. If, on the other hand, we proceed by steps from northern Europe to the Sudan, a great many intermediate and overlapping steps between these extreme forms will be found, so that only the extremes would really be entirely separate. While it may be that two races are quite distinct with regard to certain features, there are always other features with regard to which the differences are so slight that the assignment of any one individual to either one race or the other would be beset with doubt.

It has been customary to express the differences between racial types by the difference between the averages of each type or between the modes (the most frequent values) that are characteristic for each type.

It is easily shown that such a description is misleading. If we wish to express the difference between two individuals, each of whom has constant characteristics, we may proceed in this manner. If one individual measures 170 cm. and another 165 cm., the difference between them is 5 cm. If, however, a certain population has an average stature of 170 cm., and another population an average stature of 165 cm., we cannot say that the difference between the two is 5 cm., because if there is a wide range of variability there will be a large number of individuals among the taller population who have exactly the same statures as individuals of the shorter population. To give arbitrarily selected figures, the one may range perhaps from 150 to 190 cm., the other from 145 to 185 cm. In this case an individual that measures anywhere between 150 and 185 cm. might belong to either class. It must, therefore, be clear that if we speak of differences between two races we do not necessarily mean differences between individuals, and these two concepts must be kept clearly apart. The bulk of our modern literature concerning racial differences is open to misinterpretation owing to a lack of a clear understanding of the significance of the term "difference" as applied on the one hand to individuals and on the other hand to races. The generalization, which is often made (to use our previous instance), that the one population is 5 cm. shorter than the other is often interpreted as meaning that this implies a characteristic of all the individuals of a race, while actually a single selected individual of the shorter race may be much taller than a single selected individual of the taller race. This is equally true of all those anatomical, physiological, and psychological characteristics which exhibit overlapping of individuals. It is also true of those that show no overlapping, because the difference between two selected representative individuals may vary within wide limits. If it is stated that the whites have a larger brain than the negroes, this does not mean that every white person has a larger brain than any negro, but merely that the average of the negro brains is lower than the average of the brains of the whites. With regard to many characteristics of this kind, we find that the difference between the averages of different races is insignificant as compared to the range of variability that occurs within each race.

An additional point should be considered in connection with this phenomenon. Most of the anatomical characteristics of the body are stable throughout adult life, until senile degeneration begins. On the other hand, physiological and psychological functions are not the same in the same individual at all times. They vary strongly with environmental conditions and particularly with different demands made upon the organism. The variability of physiological and psychological responses is therefore much greater than the variability of anatomical form, because the two former combine the variability due to the difference in the functioning in various individuals with the variations of response under varying conditions. When comparing racial types we must therefore avoid expressing a difference of types simply as a difference of averages.

Another point must be considered which may be illustrated by an example. Let us assume that in one area the color of the hair varies from black to dark brown with an average value on a certain definite shade, and that in another population the color of the hair varies from dark blond to very light blond with an average on a certain shade of blond. In this case the two distributions will not overlap at all. On the other hand, let us assume that we have two populations with the same average shades of brown and of blond as before, but in the one a variation which begins with black and extends into blond shades, and in the other a pigmentation which begins with a very dark brown and extends into very light blond, so that the two overlap. Obviously the two differences will not impress us as the same, notwithstanding the fact that the two averages remain the same. It is therefore indispensable that in an investigation of this kind the significance of the difference between two populations should be clearly expressed, and that the impression should be avoided that the difference between racial types is identical with the difference between individuals.

Still another point deserves attention. Many writers assume that an individual of a certain type represents the same biological type regardless of the racial group to which he belongs. To give an example: a round-headed person of the Tyrols is equated with a round-headed person of southern Italy, at least in so far as the form of the head is concerned. Even if we assume that the round-headedness of the two individuals is of the same kind, this inference is not tenable. It is true that by chance the two individuals may belong to the same lines of descent, but a study of a series of homologous individuals shows that physiologically they are not the same, notwithstanding the sameness of the particular trait that is made the subject of study. When we select, for instance, individuals with the same head-index of 82 in a population that has the average head-index of 85, the children of the selected group will be found to have an average head-index of 84; when we select individuals with the same head-index of 82 in a population that has the average head-index of about 79, the children of the selected group will be found to have an average head-index of about 80, for the reason that there will be in each case reversions to the average type of the population to which the selected group belongs. In other words, the individuals which are selected from any population must always be considered as part of this population and cannot be studied as though they were an independent group.

### EUGENICS

One of the reasons for the special stress that is laid upon race investigations is the fear of race degeneration. It is assumed that the intermixture between different racial types and the rapid increase of the poorest part of the population have a deteriorating effect upon the nation. In the introductory remarks I have tried to show that there is little reason to believe that racial intermixture of the kind occurring in the United States at the present time should have a deteriorating effect. I do not believe that it has been adequately proved that there is a clearly marked tendency toward general degeneration among all civilized nations. In modern society the conditions of life have become more varied than those of former periods. While some groups live under most favorable conditions that require active use of body and mind, others live in abject poverty and their activities have more than ever before been degraded to those of machines. At the same time the variety of human activities is much greater than it used to be. It is therefore quite intelligible that the functional activities of each nation must show an increased degree of differentiation, a higher degree of variability. Even if the general average of the mental and physical types should remain the same, there must be a larger number now than formerly who fall below a certain given low standard, and also a larger number who exceed a given high standard. The number of defectives can be counted by statistics of poor relief, delinquency, and insanity, but there is no way of determining the increase of those individuals who are raised above the norm of a higher standard, and they escape our notice. It may therefore very well be that the number of defectives increases without influencing the value of a population as a whole, because it is merely an expression of an increased degree of variability.

Furthermore, arbitrarily selected absolute standards of value do not retain their significance. Even if no change in the absolute standard should be made, the degree of physical and mental energy required to keep oneself under modern conditions above a certain minimum of achievement is greater than it used to be. This is due to the greater complexity of our life and to the increasing number of competing individuals. Greater capacity is required to attain a high degree of prominence than was needed in other periods of our history. The claim that we have to contend against national degeneracy must, therefore, be better substantiated than it is now.

The problem is further complicated by the advance in public hygiene which has resulted in lowering infant mortality and has thus brought about a change in the composition of the population, in so far as many who would have succumbed to deleterious conditions in early years enter into the adult population and must have an influence upon the general distribution of vitality.

Notwithstanding the doubtful basis of many of the assertions relating to degeneracy, the problem of eugenics is clearly before the public, and the investigation of racial and social types cannot be separated from the practical aims involved in the eugenic movement.

The fundamental thought underlying eugenic theory is that no environmental influences can modify those characteristics which are determined by hereditary nature. *Nurture,* it is said, cannot overcome *nature.*

We should recall here what has been said before regarding the difference between the characteristics of hereditary strains and those of races, and that while it is true that strains differ greatly in physical and mental vigor and in specific characteristics, it is not equally true of races as a whole, because strains which are very much alike in all these characteristics are found in every single race. Even if it is not possible to prove with absolute certainty the complete identity in mental traits of selected strains belonging to races as diverse as Europeans and negroes, there is not the slightest doubt that such identity prevails among the various European types. Eugenics, therefore, cannot have any possible meaning with regard to whole races. It can have a meaning only with regard to strains. If the task of the eugenist were the selection of that third of humanity representing the best strains, he would find his material among all European and Asiatic types, and very probably among all races of man; and all would contribute to the less valuable two thirds.

As an objection to this point of view it is sometimes claimed that closely allied animal types are so different in their physical make-up and mental characteristics that members of one race can be clearly differentiated from those of another race. It is, for instance, said that the race-horse and the heavy dray-horse are so different in character that no matter what may be done to the dray-horse its descendants can never be transformed into race-horses. This is undoubtedly true, but the parallelism between the races of dray-horses and race-horses on the one hand and human races on the other is incorrect. The races of horses are developed by careful selection, by means of which physical and mental characteristics are fixed in each separate strain, while in human races no such selection occurs. We have rather a racial panmixture, which brings it about that the racial characteristics are distributed irregularly among all the different families. As a matter of fact, dray-horses and race-horses correspond to family strains, not to human races, and the comparison is valid only in so far as race-horses and dray-horses are compared to the characteristics of certain family lines, not to human races as a whole. In Johannsen's terminology the human races are to a much greater extent phenotypes than races of domesticated animals.

For this reason the task of eugenics cannot be to devise means to suppress some races and to favor the development of others. It must rather be directed to the discovery of methods which favor the development of the desirable strains in every race.

This problem can be attacked only after the solution of two questions. First of all, we have to decide what are the desirable characteristics; and secondly, we must determine what characteristics are hereditary. With regard to the former question, we shall all agree that physical health is one of the fundamental qualities to be desired; but there will always be fundamental disagreement as to what mental qualities are considered desirable—whether an intense intellectualism and a repression of emotionalism or a healthy development of emotional life is preferable. Obviously, it is quite impossible to lay down a standard that will fit every person, every place, and every time, and for this reason the application of eugenic measures should be restricted to the development of physical and mental health. Even if it were possible to control human mating in such a way that strains with certain mental characteristics could be developed, it would seem entirely unjustifiable for our generation to impose upon future times ideals that some of us may consider desirable. It might furthermore be questioned whether the interests of humanity will be better served by eliminating all abnormal strains which, as history shows, have produced a number of great men who have contributed to the best that mankind has done, or by carrying the burden of the unfit for the sake of the few valuable individuals that may spring from them. These, of course, are not scientific questions, but social and ethical problems.

For the practical development of eugenics it is indispensable to determine what is hereditary and what is not. The ordinary method of determining heredity is to investigate the recurrence of the same phenomenon among a number of successive generations. If, for instance, it can be shown that color-blindness occurs in successive generations, or that certain malformations like polydactylism are found repeatedly in the same family, or that multiple births are characteristic of certain strains, we conclude that these are due to hereditary causes; and if parents and children have the same head form or the same or similar statures, we decide that these similarities also are due to heredity. It must be recognized that in many of these cases alternative explanations are conceivable. If, for instance, a family lives under certain economic conditions which are repeated among parents and children, and if these economic conditions have a direct influence upon the size of the body, the similarity of stature of parents and children would be due to environment and not to heredity. If a disease is endemic in a certain locality and occurs among parents and children, this is not due to heredity but to the locality which they inhabit. In other words, wherever the environmental conditions have a marked influence upon bodily characteristics, and wherever these environmental conditions continue for a number of generations, they have an effect that is apparently identical with that of heredity. In many cases the causes are so obvious that it is easy to exclude persistence of characteristics due to environment. Under other conditions the determination of the causes is not so easy.

It is still more difficult to differentiate between heredity and congenital features. For example, if a child before birth should be infected by its mother, there might be the impression of a hereditary disease, which, however, is actually only congenital in the sense that it is not inherent in the structure of the germ plasm. Although the distinction between environmental causes as previously defined and hereditary causes is generally fairly easy, the distinction between congenital causes and true hereditary causes is exceedingly difficult, in many cases impossible. The long continued discussions relating to hereditary transmission of disease are a case in point. Most of these questions cannot be solved by statistical inquiries, but require the most careful biological investigation. The conditions, however, are such that we must demand in every case a clearer differentiation between these three causes.

There is little doubt that in the modern eugenic movement the assumption of hereditary transmission as a cause of defects has been exaggerated. Although certain mental defects that occur among well-to-do families seem to be determined by heredity, the mental defects generally included in eugenic studies are of such a character that many of them may readily be recognized as due to social conditions rather than as expressing specific hereditary traits. A weakling who is economically well situated is protected from many of the dangers that beset an individual of similar characteristics whose economic condition is not so favorable, and it must be admitted that criminality in families that may be mentally weak and which are at the same time struggling for the barest subsistence is at least as much determined by social conditions as by heredity. Investigators of criminal families have succeeded in showing frequencies of occurrence of criminality which are analogous to frequencies which may be due to heredity, but they have failed to show that these frequencies may not as well be explained either wholly or in part by environmental conditions. We should be willing to admit that among the poor undernourished population, which is at the same time badly housed and suffers from other unfavorable conditions of life, congenital weakness may develop which lowers the resistance of the individual against all forms of delinquency. Whether this weakness is hereditary or congenital is, however, an entirely different question. Experiments made with generations of underfed rats[1] suggest that a strain of rats which has deteriorated by underfeeding can be fed up by a careful amelioration of conditions of life, and it may well be questioned whether delinquent strains in man may not be improved in a similar way. Certainly the history of the criminals deported to Australia and of their descendants is very much in favor of such a theory. In other words, it seems very likely that the condition of our subnormal population is not by any means solely determined by heredity, but that careful investigations are required to discriminate between environmental, congenital, and hereditary causes.

## FORMULATION OF PROBLEM

From the preceding discussion, we may formulate the principal problems that must be taken up in a study of the population of the United States. We have to investigate first the degree of homogeneity of the population; second, the hereditary characteristics of the existing lines; third, the influence of environment; fourth, the influences of selection. On the basis of the data thus collected, we have to interpret the significance of the differences between various types, and investigate the bearing that our results may have upon public policies.

The study of the adult population alone would not give us adequate data to enable us to clear up the causes which determine the final development of the body—the events which take place during the period of growth must also be taken into consideration.

Familiarity with the bodily forms of children is necessary also from a morphological point of view. On the whole, the development of individuals is divergent, so that the most characteristic forms of each type are found in the adult male. The adult female forms are not quite so divergent, perhaps in part for the reason that the period of development of the female is shorter than that of the male, although it must be remembered that secondary sexual characteristics are present in childhood. The younger the human form that we investigate, the less clearly are racial characteristics expressed. We may, therefore, say that the most generalized forms of a racial type will be found in the infant or, even still more clearly, in prenatal stages, while the most highly specialized local forms will be found in the male adult. A knowledge of the specialized forms ought to include, therefore, a study of progressive differentiation. Particularly for the study of the influences of environment it is indispensable that the development of the body in childhood should be studied while the influences are still at work. We have to know the conditions which bring about retardation or acceleration in the development of various parts of the body, and their ultimate effects upon the human form. We must study other minute changes that may perhaps not be related to retardation or acceleration, but that may be due to a direct effect of environmental causes. In the adult these changes have been completed and can no longer be subjected to analysis, while in the growing child, their gradual development and unfolding may be observed.

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[1] Helen Dean King, *Studies on Inbreeding*, Wistar Institute, 1919.

The same is true with regard to selection. If selection is related to bodily form, it will probably act with particular intensity during the early years of childhood. It might be revealed by a comparison of the surviving and dying parts of the population of various ages.

These considerations make it quite necessary to include in the study of the population, not only adults, but also children.

One method of approach should consist, therefore, in the study of the growth and development of children, classified according to descent and geographical and social environment. If it were feasible to include records of the longevity of the individuals measured in childhood, the problem of selection could also be attacked. In the study of adults a careful classification according to descent and social position will be necessary.

The phenomena of homogeneity and of heredity make it necessary that the investigation should not be confined to studies of individuals, but that the anatomical characteristics of families should be made the subject of inquiry.

A considerable amount of work has been done by many investigators, throwing light upon a number of aspects of the problems here discussed. The earliest and most extensive series of observations was collected in connection with the War of the Rebellion and was published by Gould and Baxter.[1] Their well-known statistics, which have been quoted again and again, give data with regard to the stature of enlisted men according to their nativity, descent, and occupation, and reveal the facts that inhabitants of different parts of the United States differ in their physical development; that the differences between the various European nationalities are repeated here; but that in every single case, the members of a certain nationality exceed in bulk of body the corresponding European series; and, finally, that certain differences may be observed between groups of individuals following different occupations.

The next important inquiry relating to our subject was an investigation of school children of Boston by Henry P. Bowditch,[2] in which similar differences appeared. Bowditch also showed that the differences between various nationalities persisted throughout the period of growth, and that marked differences are found according to social stratification. Classification of the population according to the occupation of the parents showed a better development among the commercial and professional classes than is found among unskilled labor. Soon after Bowditch's investigation similar inquiries were instituted by Peckham[1] in Milwaukee, and later on in a number of other cities—Worcester, Mass.;[2] St. Louis, Mo.;[3] Toronto, Canada;[4] Oakland, Cal.,[5] etc. On the whole, the methods pursued were similar to those applied by Bowditch, and the results proved the occurrence of analogous phenomena. Porter, in his investigation in St. Louis, added to his inquiries the problem of the relative development of the children of varying mental achievement, and demonstrated a difference in the development of what he called precocious and dull children. Work of this type was gradually taken up by educational institutions and the effort was made to correlate physical development with school work, with a view to demonstrating a practical way of assigning a child to his proper developmental stage.

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[1] B. A. Gould, *Investigations in the Military and Anthropological Statistics of American Soldiers*, New York, 1869.

[2] H. P. Bowditch, "The Growth of Children," Eighth Annual Report, Massachusetts Board of Health. Boston, 1875, pp. 273–323; Tenth Annual Report, 1879, pp. 33–62; 21st Annual Report, 1890, pp. 287–304; 22nd Annual Report, 1891, pp. 479–525.

In similar investigations in Europe attention had been called to the fact that the measurement of children of different ages and the calculation of a growth curve on this basis does not give us adequate information with regard to the details of the phenomena of growth, and it was pointed out that repeated measurements of the same individual are necessary to obtain fuller records. In spite of numerous efforts that have been made to obtain such series, it has not been possible up to the present time to follow out the development of the same individual from childhood to adult life, at least not in numbers that are sufficient for a clear understanding of the phenomena involved in this process.

A certain amount of material bearing upon stature and weight has been collected by life insurance companies. This, however, is probably to a great extent so uncertain that it is of slight use only for scientific investigations. Military statistics taken in the United States since the War of the Rebellion are not numerous and not very extensive. A certain amount of work was done during the recent war, but the results have only now been made accessible. The only fairly extended investigation of families that has been undertaken in the United States was made in connection with the work of the Immigration Commission, during which a fairly large number of Jewish, Bohemian, Italian, and Slavic families were studied in such a manner that the phenomena of heredity could be considered in some detail.

We have practically no material whatever bearing upon the facts of racial mixture. It is particularly worth remembering that there are hardly any investigations to speak of that bear upon the physiological development of the negro and mulatto population. In view of the ever-repeated claim that the mulatto is inferior in physical development to either the pure negro or to the white, and considering the large number of mulattoes in our population, it seems of fundamental importance that an investigation of this kind should be made.

Although less important from a practical point of view than the negro problem, race mixture between whites and Indians has received some attention. Material collected in 1892 shows that the half-blood, so far as fertility and stature are concerned, is superior to the full-blood Indian.[6] The observations relating to fertility were confirmed by the material collected in the census of 1910.[1] Recently an inquiry into the characteristics of the half-bloods of Minnesota was made by Professor Albert E. Jenks.[2] We are still lacking, however, full investigations into the anatomical and physiological characteristics of half-bloods.

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[1] C. W. Peckham, "The Growth of Children," Report of Wisconsin Board of Health, 1881, pp. 28–73.

[2] Franz Boas and Clark Wissler, "Statistics of Growth," Report U. S. Commission of Education, 1904, pp. 25–132.

[3] W. T. Porter in the Transactions of the Academy of Sciences of St. Louis, "The Physical Basis of Precocity and Dullness," 1893, pp. 161–81; "The Relation between the Growth of Children and their Deviation from the Physical Type of their Sex and Age," 1893, pp. 263–80; "The Growth of St. Louis Children," 1894, pp. 263–380; also Quar. Pub. of Amer. Stat. Ass'n, NS 3, pp. 577–87, 4, 28–34.

[4] Franz Boas, "The Growth of Toronto Children," Report U. S. Commission of Education for 1896–97, pp. 1541–99.

[5] Franz Boas, "The Growth of Firstborn Children," *Science* NS I, pp. 402–404.

[6] Franz Boas, "The Half-Blood Indian, an Anthropometric Study," *Popular Science Monthly*, Vol. 45, 1894, pp. 761–70.

Louis R. Sullivan, "Anthropometry of the Siouan Tribes," Anthropological Papers of the American Museum of Natural History, Vol. 23, Part III, p. 199.

The problem of the intermixture between negro and white and negro and Indian has hardly been touched at all. A few studies of negro children and soldiers do not contribute much to our knowledge. A systematic study of the problem was made by Felix von Luschan in 1915, but the results of his observations are not yet available. Another important inquiry is that by Eugen Fischer on the Rehobother Bastards, the descendants mainly of Dutch settlers and Hottentots in South Africa. This is the only work in which the anthropological characteristics of the mulattoes have been taken up in detail. The theoretical as well as the practical importance of the investigation of the mulatto question can hardly be sufficiently emphasized. On the one hand, we may hope to obtain by this means an insight into the laws of heredity in man. On the other hand, the well-being of so many millions of citizens of our country is involved that the most painstaking inquiry should be demanded. This is the more urgent since many states have regulated race intermixture by laws which are based simply upon public prejudice without the shadow of knowledge of the underlying biological facts—without even the knowledge of the peculiar form of racial intermixture that characterizes the relations between whites and negroes in the United States. In by far the greater number of cases the mother is a negress and the father a white man. This results in an infusion of white blood into the negro race without affecting materially the white race. A searching analysis of the hereditary characteristics of the racial groups has not yet been made. It is true that the records of morbidity suggest typical physiological differences, but considering the fact that similar differences are found between different social groups of the same race, it is not possible without further investigation to distinguish definitely between the influences of heredity and of social environment.[3]

I refrain from giving a detailed bibliography and review of the anthropometric material collected in the United States in view of the very excellent collection of titles made by Professor Bird T. Baldwin, of the Bureau of Child Study of the University of Iowa.[4]

### PROPOSED INVESTIGATIONS

The first and most fundamental inquiry that has to be made relates to a description of the various types constituting the population of the United States. As explained before, it will not be sufficient to describe the adult male and female forms, but it will also be necessary to determine the course of growth and development which is characteristic of each form. In order to carry through this inquiry it is necessary to obtain information with regard to the forms characteristic of each moment of the period of the development, and to determine the sequence of the characteristic developmental stages of each type. It is not admissible to assume that the physiological conditions which are found in a six-year-old Italian child must be the same as those of a six-year-old Scandinavian child. Furthermore, the individuals of each racial group will differ among themselves considerably with regard to the time when certain stages of physical development are reached, and it is therefore necessary to investigate fully the variability of physiological development characteristic of each group. A little work of this kind has been done. Pryor's and Roach's investigations of ossification, a number of inquiries into the eruption of teeth, Crampton's investigations on the approach of puberty, all relate to this subject. The material collected is, however, entirely inadequate and does not give a clear insight into the conditions that determine the variation in time when certain phenomena set in. The following table shows the rough values which are available at the present time, indicating the period when certain characteristic features develop, and the variability of occurrence of this period.

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[1] Roland B. Dixon, *Indian Population in the United States and Alaska*, 1910; Washington, 1915, pp. 157–60.

[2] *Indian-White Amalgamation*, University of Minnesota Studies in Social Science, No. 6, Minneapolis, 1916.

[3] See also E. B. Reuter, *The Mulatto in the United States*, Boston, 1918.

[4] *The Physical Growth of Children from Birth to Maturity.* Iowa Child Welfare Research Station Study, Vol. I, No. 1.

| Age in years | Observation | Variability in years |
|---|---|---|
| 0.0 | Pregnancy | ±0.04 |
| 0.6 | Eruption of first incisors | ±0.21 |
| 1.6 | " " first molars | ±0.31 |
| 4.2 | Ossification of scaphoid bone, girls | ±1.4 |
| 4.2 | Ossification of trapezoid bone, girls | ±1.2 |
| 5.8 | Ossification of scaphoid bone, boys | ±1.1 |
| 6.2 | Ossification of trapezoid bone, boys | ±1.3 |
| 7.0 | Eruption of inner permanent incisors, girls | ±1.6 |
| 7.5 | " " inner permanent incisors, boys | ±1.4 |
| 8.9 | " " outer permanent incisors, girls | ±2.1 |
| 9.0 | " " bicuspids, girls | ±2.8 |
| 9.5 | " " outer permanent incisors, boys | ±2.1 |
| 9.8 | " " bicuspids, boys | ±1.6 |
| 11.2 | " " permanent canines, boys | ±1.4 |
| 11.3 | " " permanent canines, girls | ±1.0 |
| 12.7 | Beginning of pubescence, boys | ±1.6 |
| 12.8 | Eruption of second molars, girls | ±1.6 |
| 13.2 | " " second molars, boys | ±2.0 |
| 14.6 | Completed pubescence, boys | ±1.1 |
| 14.9 | Puberty, girls | ±2.0 |
| 19.3 | Eruption of wisdom teeth, boys | ±2.1 |
| 22.0 | Eruption of wisdom teeth, girls | ±1.8 |
| 35.0 | Preauricular wrinkles | ±6.6 |
| 36.5 | Hair on tragus | ±8.3 |
| 44.5 | Menopause | ±5.3 |
| 62.5 | Death due to arterial diseases, men | ±13.2 |

Any attempt to subdivide this series according to nationality or environmental conditions would be premature, except for the period of adolescence for which more extensive statistics are available. It must be considered one of the most urgent aims of an investigation to determine the sequence of events and the racial and environmental conditions that influence them. There are indications that these problems may be found to be exceedingly intricate. Thus we have evidence to show that the development of poor children is considerably retarded. Nevertheless, it seems that the second dentition among these children is accelerated. This may perhaps be due to less care given to the deciduous teeth and their earlier loss which stimulates the appearance of the permanent teeth—or it may be due to other causes. It is, however, an indication that the sequence of events indicating the physiological changes in the body are subject to quite diverse causes.

The determination of all phenomena of this kind is very difficult when the attempt is made to derive data by the so-called generalizing method, that is to say, if we merely collect information that children of a certain age show the stage of development in question so and so often, and if we try to derive the rate of development by subtracting the relative frequency of occurrence observed in one year from the relative frequency of occurrence in the next year. If we observe, for instance, that a certain tooth is present in 50 per cent of the children of one age and in 70 per cent of another set of children who are one year older, and conclude that in 20 per cent of the children the tooth in question will erupt in the course of that year, the different composition of the annual groups and the different numbers observed make it difficult to obtain reliable results. It is almost indispensable that for each individual there should be noted the moment of occurrence of the physiological change which is being studied. Material of this type is almost non-existent.

The movability of our modern city populations causes great practical difficulty in the organization of this work. It is not easy for an investigator to remain in touch for a sufficiently long time with the same children, and so many children change from one place to another that an initial number of, let us say one hundred, who are studied when five years old, will have dwindled down to an insignificant number at the time when the adult stage is reached. For this reason an elaborate organization is needed to carry through this work completely. To a greater or less extent, the work must be pieced together of fragments. For children of school age, roughly speaking from four or five years to fourteen years, the investigation might be organized. For older children of high-school age, it will also ordinarily be possible to carry through the inquiry, and in certain cases the transfer of a subject from high school to college may also be followed up. It is, however, obvious that the individuals who can be followed in this way are a group selected according to economic and social conditions. Those groups of the population which are well-to-do and who lay great stress upon the acquisition of a good education will be represented much more fully than other groups. The observations for different ages will therefore require a consideration of the different composition of the series. An organization like the Child Study Bureau of Chicago or the corresponding organizations in Iowa City and Detroit, or the Association for the Improvement of the Conditions of the Poor in New York, will be best able to control inquiries into these subjects.

The most difficult problem encountered in these investigations is the differentiation between hereditary differences and those due to retardation or acceleration. To give an example: A boy twelve years old may be tall because his hereditary characteristics are such that he belongs to a tall stock, or it may be that he is tall on account of an acceleration of his development. Since, furthermore, the adult stature of the individual will depend not only upon his hereditary characteristics, but also upon environmental conditions that have an effect upon the acceleration or retardation of his growth, it is difficult to determine directly how much is contributed by hereditary and how much by environmental causes. From a practical point of view the demand is always made that the anthropometric investigation of the individual shall differentiate between these two causes.

In most cases, however, it seems almost impossible to do so, except by a very detailed investigation of the physiological conditions of the body. Measurements are always subject to alternative explanations, as being due either to hereditary causes or to acceleration or retardation, while physiological changes are not so likely to be fundamentally different for different hereditary lines. If, for instance, in a certain individual the loss of healthy deciduous canines should be very much retarded, we should have the right to assume that, in whole or in part, his bodily development may be influenced by retardation. This, of course, presupposes a previous investigation which would show that the hereditary characteristics of different strains do not show very great differences in the time element of the loss of the first canine, provided the environmental conditions remain the same. Here, again, we are entirely lacking in material that would enable us to answer this question, and it is evident that a very considerable amount of information would have to be amassed in order to enable us to solve the problem. It does not seem a hopeless task to determine the contributory effect of retardation and acceleration in an individual child, but it presupposes a much more thorough knowledge of the sequence of the developmental stages than we now possess.

The description of racial types cannot be considered complete without an inquiry into the homogeneity or the heterogeneity of the series. It is clear from the remarks made on page 185 that this problem can be solved only by an investigation of the forms represented in fraternities, because homogeneity can be proved only by showing that the types represented in different families are the same. In other words, the investigation of homogeneity must be based on an inquiry into the variations presented by different families. The small size of the human family makes it necessary to see to it that the proper weight is given to each fraternity in accordance with its numerical composition.[1] This investigation must be supplemented by an inquiry into each fraternity, the variability of which will depend upon the more or less composite character of its ancestry.

We are thus led to a consideration of the problem in how far it is possible to discover relative unity or multiplicity in the ancestry of a racial type. The method to be pursued will depend entirely upon the laws of heredity involved. In those cases in which we have some kind of Mendelian inheritance—that is to say, a tendency of the offspring to revert to either parental type—we must obviously expect a higher degree of variability in the mixed types than the one found in the pure parental types. Attention has been called to the occurrence of such a phenomenon with regard to the head index of Italians.[2] The short-headed north Italians are, comparatively speaking, uniform in type, and the long-headed south Italians are also fairly uniform in type, while in the intermediate regions in which undoubtedly the two types have intermingled for a long period, the variability of the head-index is very much increased. In a similar way, we find that there is an increase of variability in Sweden in those regions in which there is an admixture of foreign types that are more short-headed than the Swedes.[3] It has also been shown that in those cases in which father and mother belong to the same racial group, but in which they represent extreme head forms, the one extremely short-headed, the other extremely long-headed, the variability of the children is greater than in those cases in which the parents represent nearly the same type.[4] We recognize, therefore, that when a Mendelian reversion occurs, increased variability may indicate composite descent.

There are, however, other cases in which the results of mixture have not the effect of increasing variability. Statistics of half-blood Indians have shown that the width of face, which is very great in the Indian race and very small in the white race, has an intermediate value among the half-bloods, with a marked tendency, however, of reversion to a form that is narrower than the face of the pure Indian and wider than the face of the pure white, while the values for width of face which are half-way between the characteristic values of the Indians and of the whites are not so frequent as the two other values previously mentioned. There is, therefore, a certain kind of reversion in this case. Nevertheless, the total variability of the width of face of the half-bloods is almost the same as that of the pure parental types, if anything a little less.[1] If we assume in this case a pure reversion to either type, we should find that the variability would be considerably more than that of the parental races. It appears, therefore, that we cannot generalize with regard to the phenomenon, and we have not the right to assume that mixture will always be accompanied by increased variability and that slight variability does not always indicate purity of descent.

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[1] See footnote on p. 187.

[2] Franz Boas and Helene M. Boas, "The Head-Forms of the Italians as influenced by Heredity and Environment," *American Anthropologist*, Vol. 15, 1913, p. 163 *et seq.*

[3] Franz Boas, "Notes on the Anthropology of Sweden," *Amer. Jour. of Physical Anthropology*, Vol. 1, p. 415 *et seq.*

[4] Boas, *Changes in Bodily Form of Descendants of Immigrants*, Columbia University Press, New York, 1912, p. 76 *et seq.*

Whenever the laws of heredity are of a still different type, the variability may be affected in a very different manner. Thus it has been shown that mixture between Europeans and Indians results in a stature which exceeds that of the pure Indians, which in turn is greater than that of the pure whites. It is obviously quite impossible to predict in this case what the variability of the series may be.

Another method of investigating mixed descent of a race is by means of a study of the correlations of different measurements of the body. To give an instance: when two people intermingle, one of which has very long and very narrow heads, while the other has very short and very broad heads, and if, furthermore, reversion to parental forms obtains, then we must expect that among the individuals representing this population very broad heads are commonly associated with shortness, while very narrow heads are associated with greater length. We should, therefore, expect of such a population that the broader the head, the shorter it will be. In other cases, where we have a single line of descent, the condition is reversed. The size of the head depends upon the bulk of the body, and since in such a case broad heads are indicative of length of body, the length of head is also increased, and we find that a broad head is associated with greater length of head. In the case mentioned before, the reversion of the normal correlation is indicative of mixed descent.

Here again many variations may occur. If, for instance, we had two races intermingled with a tendency to reversion to parental forms in which the heads of one group are very high and at the same time narrow and short, while those in the other group are flat and at the same time broad and long, then the result would be that in the study of the correlation between length and breadth of head, the correlation would appear inordinately high, because all the shortest heads would belong to the high type and would, therefore, also be narrow, while all the longest heads would belong to the low type and would also therefore be broad.

A characteristic case in which heterogeneity of a series causes abnormal correlation between physical features is found in Italy. Normally there is practically no correlation between hair color and stature, but in Italy the tall Alpine type has lighter hair than the short Mediterranean type. In Piedmont where the Mediterranean type is practically absent we find the following distribution:

| Stature | HAIR | | | |
|---|---|---|---|---|
| | Red | Blond | Brown | Black |
| Less than 160 | 0.5 | 12.3 | 64.1 | 23.1 |
| 160–165 | 0.8 | 12.4 | 63.9 | 22.9 |
| 165–170 | 0.8 | 12.2 | 63.4 | 23.6 |
| 170 and more | 0.8 | 12.9 | 64.3 | 22.0 |

In Sicily where the Alpine type is practically absent we find:

| Stature | HAIR | | | |
|---|---|---|---|---|
| | Red | Blond | Brown | Black |
| Less than 160 | 0.3 | 4.8 | 56.8 | 38.1 |
| 160–165 | 0.4 | 5.1 | 55.7 | 38.9 |
| 165–170 | 0.4 | 5.2 | 56.6 | 37.8 |
| 170 and more | 0.5 | 5.0 | 56.6 | 37.9 |

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[1] Franz Boas, "Zur Anthropologie der nordamerikanischen Indianer," Verhandlungen der Berliner Anthropologischen Gesellschaft, 1895, p. 404 *et seq.*

Louis R. Sullivan, "Anthropometry of the Siouan tribes," Anthropological Papers of the American Museum of Natural History, Vol. 23, pp. 3, 136, 161.

In Venice and Latium, on the other hand, where mixed types occur, we find:

| Stature | HAIR | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Venice | | | | Latium | | | |
| | Red | Blond | Brown | Black | Red | Blond | Brown | Black |
| Less than 160 | 0.8 | 10.1 | 63.8 | 25.3 | 0.7 | 5.4 | 60.5 | 33.4 |
| 160-165 | 0.7 | 11.9 | 62.0 | 25.4 | 0.6 | 6.1 | 60.6 | 32.7 |
| 165-170 | 0.8 | 12.8 | 60.9 | 25.5 | 1.1 | 6.4 | 60.7 | 31.9 |
| 170 and more | 0.8 | 14.0 | 61.2 | 23.6 | 0.6 | 8.2 | 62.4 | 28.8 |

and still more clearly for the whole Kingdom:

| Stature | HAIR | | | |
|---|---|---|---|---|
| | Red | Blond | Brown | Black |
| Less than 160 | 0.5 | 7.0 | 59.7 | 32.8 |
| 160–165 | 0.5 | 7.9 | 60.0 | 31.6 |
| 165–170 | 0.6 | 8.5 | 60.1 | 30.8 |
| 170 and more | 0.6 | 9.5 | 61.0 | 28.8 |

On account of the greatly varying laws of heredity it is impossible to predict which method of inquiry will lead to a satisfactory result. By some of the means here described the problem of pure or mixed descent may be approached.

The study of any particular type will, therefore, require a multiplicity of investigations, the most important of which relate to the development of the racial type from childhood on, the homogeneity of the series, and the purity of the ancestry. For these purposes the investigations of children and of families are indispensable and must accompany a generalized investigation of the population as a whole.

For the study of the influence of environment the investigation of growing children is, if anything, more important than for the investigation of racial characteristics. After the adult stage has been reached environment will not exert any further influence. The earlier in life the investigation can begin, the more likely we are to obtain adequate results.

In this investigation the generalizing method of comparing local types or types presented in social strata is of little use, because in order to establish definitely an influence of environmental causes, we must be certain that the hereditary composition of the populations which we study is the same. For instance, when we compare a rural and an urban community, there is nothing that will guarantee to us that both populations are derived from the same ancestry. On the contrary, we may assume that the urban population is drawn from a wider group than the rural population. In the same way, when we compare the inhabitants of a long secluded valley and find differences in bodily form between the people living in the lower part and those living in the upper part, the question would arise whether the ancestry of the two groups is the same and whether the people in the upper regions have not been more isolated than those farther down. It is on the whole easier to exclude obvious environmental influences in an investigation of racial types than to exclude differences of racial descent in studies of the influence of environment. The only way to escape from these complications is by confining the studies strictly to a comparison between parents and children.

It has been explained before that in a number of cases we may find apparent hereditary traits which may be deduced from the similarity of parents and their own children, and which nevertheless are primarily due to environmental causes. If we should find, for instance, a low stature among individuals who have been undernourished as children, and if the next generation will also be undernourished, we may have an apparent similarity in stature which is not due primarily to heredity, but rather to the fact that the same environmental causes act upon the parental group and upon the group of children. In most cases these elements cannot be eliminated unless we have the opportunity to study the same racial type in different forms of environment.

It has also been stated that a modification of bodily form due to environment which is observed by comparing parents and their children, does not contradict the phenomena of heredity. If we find, for instance, that the stature of Jewish immigrants into the United States is lower than that of their children, the hereditary stability of stature will nevertheless manifest itself. The children of an exceptionally tall couple who exceed the average stature of the immigrant Jew by a certain amount may be expected to show an excess of stature which is correlated to the excess of stature of the parents, which, however, has to be added to the increased average stature of the children of immigrants. In short, a change in type due to environmental influences simply means that the correlated deviations in the group of parents and of children must be reckoned from the point which is typical for the generation in question.

In some cases in which the environmental influences are very strong, a generalizing method may give adequate results. Bowditch, in his investigation of Boston children, was able to show that Irish children differ in their development according to the economic condition of the parents, and there is little reason to doubt the uniformity of the racial composition of his various Irish groups. But whenever the differences involved are slight, and when they may be equally well explained on the basis of difference in racial composition, the comparison between parents and children is indispensable. The data for the study of environmental influences must, therefore, be based on the comparison of the bodily forms of parents and their offspring. In this manner the doubt as to the difference in racial composition may be eliminated, although it is at least conceivable even in this case that there may have been selective rather than environmental influences. It might be said, for instance, that when some parents have children in charitable institutions while other children stay at home, differences between the two groups of children might not be due to environmental influences only but also to selection. This example indicates that care must be taken to eliminate the influences of selection even when we are dealing with family groups in which diversity of racial descent has been excluded.

At the present time it is unknown to what extent the influences of environment may determine bodily form. Notwithstanding the numerous claims of the fundamental effect of climate upon the body of man, we have no evidence whatever that will show that pigmentation undergoes fundamental changes under climatic conditions; that the white race would become darker in the tropics; or that the negroes would become lighter in the north. Whatever statistics we have on this subject show rather a remarkable stability of pigmentation. We have not even any definite indication that the pigmentation of the hair undergoes changes under different climatic conditions, although in this case the change in color from the period of childhood until middle life is so great that we might very well expect environmental influences to express themselves. On the other hand, we know that the bulk of the body is very susceptible to environmental influences, and it is but natural that retardation or acceleration during the period of growth will also leave their effect upon those proportions of the body which depend upon bulk. Other changes which occur very early in life are not so easily explained. I think the evidence showing that the form of the head is susceptible to environmental influences is uncontrovertible. I also believe that adequate proof has been given for modifications in the width of the face under changed conditions of life. The causes of these changes are still entirely obscure. It may well be, as suggested by Harvey Cushing, that chemical changes occur under new environmental conditions and unequally influence growth in different directions. This would agree with the changes in chemical constitution found in lower animals living in different types of environment. If it is true that changes of this kind do occur and modify the form of body so fundamentally that according to the ordinary schemes of classification a people might be removed from one group and placed in another one, then we have to consider the investigation of the instability of the body under varying environmental conditions as one of the most fundamental subjects to be considered in an anthropometric study of our population.

# THE DETERMINATION OF SECULAR TREND[1]

By W. L. Crum, *Yale University*

It is customary in the analysis of ordered statistical series of the historical economic sort to eliminate the growth factor, assumed constant, by fitting a straight line to the original data. The equation of this straight line is determined by the method of least squares [2] or by an equivalent process. At a later stage in the investigation, it is frequently desirable to consider the ratio of the deviation of a particular variate from the ordinate of the corresponding point on the line of secular trend to that ordinate, rather than the actual deviation itself.[3] The question arises whether it would not be preferable to fit the line so that the sum of the squares of these *ratios*, rather than the sum of the squares of the actual *deviations*, is minimum. It is the purpose of this paper to examine this question and to get a first approximation to the position of the line of secular trend on the new basis.

## I. THE COEFFICIENT OF CORRELATION

Suppose we have a series of $N$—$N$ being assumed odd for convenience—variates $x_i$ ordered relative to a variable $t_i$. We suppose further that the intervals between successive $t_i$ are all equal and equal to unity, and we therefore represent the $t_i$ as $i$; and moreover we take the middle $t_i$ as origin. Finally, we restrict the problem to cases in which the secular trend is substantially rectilinear and gradual, and in which the total change in $x$ is not a large fraction of the mean $x$. This would amount to saying, somewhat loosely, of a historical series, that it represented a phenomenon in a mature stage of development.

Let the position of the line of secular trend, Figure 1, be specified by two of the parameters:

$a$, the $x$-intercept; $m$, the slope; $T$, the negative $t$-intercept; which are related by the equation:

$$a = mT \tag{1}$$

Then, the equation of the line is:

$$x = m(i + T) \tag{2}$$

---

[1] Presented to the American Mathematical Society on December 28, 1921, under the title "Note on the determination of the rectilinear secular trend of an ordered series of statistical relatives."

[2] Warren M. Persons, *Review of Economic Statistics*, Jan., 1919, p. 12.

[3] *Ibid.*, p. 35, and April, 1919, p. 117 *et seq.*

the actual deviation of a particular variate, $x_i$, is:

$$x_i - m(i+T)$$

and the ratio of this deviation to $x$ is:

$$\lambda_i = \frac{x_i}{m(i+T)} - 1. \tag{3}$$

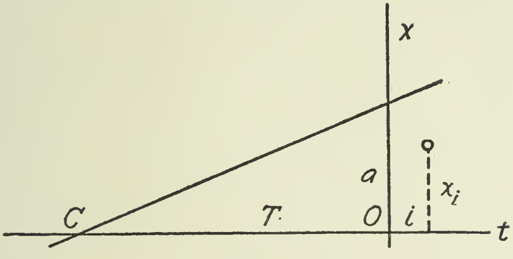

Fig-1

Because of the limitations placed upon the series, it is possible to expand in powers of $u_i = i/T$, and (3) becomes approximately:

$$\begin{aligned}\lambda_i &= \frac{x_i}{mT}(1-u_i) - 1\\ &= \frac{x_i}{a} - 1 - \frac{x_i}{a}u_i\\ &= P_i - p_i u_i \qquad (4)\end{aligned}$$

where

$$p_i = x_i/a, \ P_i = p_i - 1.$$

Moreover

$$\lambda_i^2 = P_i^2 - 2P_i p_i u_i. \tag{5}$$

Suppose now that there is a second series of $N$ variates, $y_i$, ordered relative to $t_i$, and subject to the same sort of limitations as the $x$ series. We imagine that there is a certain "lag" between the two series, so that the $t$ which belongs to the *ith* $y$ differs from that belonging to the *ith* $x$ by an amount $L$; and this lag, $L$, will be assumed constant. Then, if we take the $y$-axis at a distance $L$ from the $x$-axis, values of $x$ and $y$ belonging to the *same* value of $i$ will be associated with each other; and the analysis can proceed without further regard for the existence or amount of lag.

To distinguish between the two series, we suppose from now on that the above parameters for the $x$ series are $a_x$, $m_x$, $T_x$, and that corresponding parameters for the $y$ series are the same letters with subscript $y$. Moreover, for the $y$ series, we use $\mu_i$, $v_i$, $q_i$, and $Q_i$ to correspond to $\lambda_i$, $u_i$, $p_i$, and $P_i$.

With this notation we get the following set of approximate relations:

$$\left.\begin{array}{ll} \lambda_i = P_i - p_i u_i & , \ \mu_i = Q_i - q_i v_i \\ \lambda_i^2 = P_i^2 - 2\,P_i p_i u_i & , \ \mu_i^2 = Q_i^2 - 2\,Q_i q_i v_i \end{array}\right\} \tag{6}$$

and the typical product term, which enters in the correlation coefficient, is:

$$\lambda_i \mu_i = P_i Q_i - Q_i p_i u_i - P_i q_i v_i + p_i q_i u_i v_i. \tag{7}$$

Whereas, by the assumptions about the series, $p_i$ and $q_i$ are not far from unity; $u_i$ and $v_i$ are of the first order in the small quantity—the ratio $i/T$—and it is possible that the same is true of $P_i$ and $Q_i$, if $a_x$ and $a_y$ are not far from the arithmetic means. Thus all the terms in each of the expressions (6) and (7) are likely to be of the same order. If we were concerned with the actual deviations, the means, standard deviations, and correlation coefficient would depend upon the terms $P_iQ_i$, $P_i^2$, $Q_i^2$ and $P_iQ_i$. But, in the analysis from the point of view of the ratios $\lambda$ and $\mu$, the additional terms are likely to be equally important.

Granting that it is essential to keep all the terms in the above expressions, will their values be altered greatly if the lines of secular trend are determined by considering the ratios $\lambda$ and $\mu$, rather than the actual deviations? It is shown below that the values of $a$, as found by the two methods, do not differ greatly from each other. But the other parameter, $T$, and hence also $m$, is likely to be changed notably by applying the method of least squares to the ratios instead of the actual deviations. Hence, as $T_x$ enters in $u$ and $T_y$ in $v$, the above values are all likely to suffer considerable change. It is therefore doubtful if it is warrantable to compute the correlation coefficient of the ratios unless the line of trend for each series is located on the basis of ratios.

## II. FITTING THE LINE

We proceed next to fit a line to the $x$ series by the method of least squares, basing the calculations upon the ratios instead of the actual deviations: we seek to determine the parameters $a$, $m$, and $T$ so that the sum of the squares of the $\lambda_i$ shall be minimum. The *necessary* conditions for a minimum are that the partial derivatives of $\Sigma\lambda_i^2$ with respect to $m$ and $T$ shall vanish.

The exact expression for $\lambda_i$ is given in (3) as:

$$\lambda_i = \frac{x_i}{m(i+T)} - 1$$

from which

$$\frac{\partial \lambda_i}{\partial m} = -\frac{x_i}{i+T}, \quad \frac{\partial \lambda_i}{\partial T} = -\frac{x_i}{m}$$

giving

$$\frac{\partial \Sigma \lambda_i^2}{\partial m} = -2\sum \frac{x_i}{i+T}\lambda_i, \quad \frac{\partial \Sigma \lambda_i^2}{\partial T} = -2\sum \frac{x_i}{m}\lambda_i. \tag{8}$$

Each of these exact relations (8) is expanded in powers of $u$, and set equal to zero. Solving the two resulting equations simultaneously, and using (1), will give the following approximate values of the parameters:

$$m = \frac{1}{T}\,\frac{\Sigma x^2}{\Sigma x} \tag{9}$$

$$T = \frac{3\,\Sigma x \Sigma x^2 i^2 - 2\,\Sigma x^2 \Sigma x i^2 - \Sigma x i \Sigma x^2 i}{\Sigma x \Sigma x^2 i - \Sigma x^2 \Sigma x i} \tag{10}$$

$$a = \frac{\Sigma x^2}{\Sigma x} \tag{11}$$

The quantities involved in (9), (10), (11) are:

$$\Sigma x,\ \Sigma xi,\ \Sigma xi^2,\ \Sigma x^2,\ \Sigma x^2 i,\ \Sigma x^2 i^2$$

and these are the moments of orders 0, 1, 2, of the $x$ and the $x^2$. The computation of the parameters which locate the line necessitates, then, the calculation of these six moments.

Example (i). Consider the following ordered series:

| $x$ | 2 | 3 | 2 | 4 | 3 | 2 | 4 |
|---|---|---|---|---|---|---|---|
| $i$ | −3 | −2 | −1 | 0 | 1 | 2 | 3 |

The above formulas give for the intercepts:

$$a = 3.1; \quad T = 17.2$$

whereas computation by the usual method of least squares of the *deviations* gives:

$$a = 2.9; \quad T = 16.3.$$

The series is shown in Figure 2; and the two lines are plotted, the full line being that of the present method of calculation.

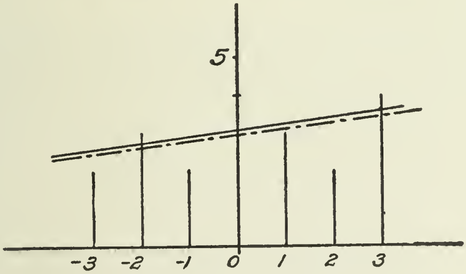

Fig-2

Example (ii). Examination of the ordered series:

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| $x$ | 9 | 9 | 10 | 8 | 9 | 11 | 10 | 12 | 11 |
| $i$ | –4 | –3 | –2 | –1 | 0 | 1 | 2 | 3 | 4 |

gives:

$$a=10.0;\quad T=62.2$$

by the method of *ratios;* and, by the method of *deviations:*

$$a=9.9;\quad T=29.7.$$

This series and its two lines are shown in Figure 3.

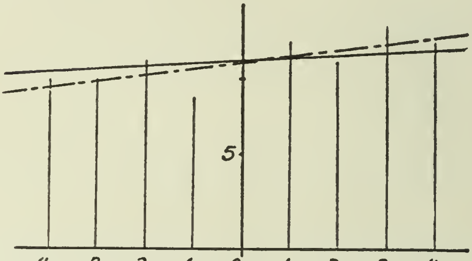

Fig-3

Example (iii). We study next a series of the historical economic type, the monthly values of building permits for twenty leading cities over a period of sixteen years as shown in the table[1] that follows. Calculation on the basis of ratios gives for the parameters:

$$a=440;\quad T=3130;\quad m=.14$$

whereas the determination depending on the actual deviations gives:

$$a=398;\quad T=1470;\quad m=.27$$

These last values are not the same as those found from the equation as given by Professor Persons,[2] but the discrepancy is due to the fact that he used only the first fourteen years of the series in fitting the line.

We observe that in each of the examples the values of $a$ found by the two methods are not greatly different from each other, and that the value found by the ratio method exceeds that found by the older method. This is true in general, for:

$$a=\frac{\Sigma x^2}{\Sigma x}=a'\left\{1+\left(\frac{\sigma}{a'}\right)^2\right\}$$

where $a'$ is the arithmetic mean, and $\sigma$ is the standard deviation, of the $x_i$. But $a'$ is precisely the value of $a$ found by the older method;

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[1] *Rev. of Econ. Stat.*, January, 1919, p. 74.

[2] *Ibid.*, p. 39.

| | '03 | '04 | '05 | '06 | '07 | '08 | '09 | '10 | '11 | '12 | '13 | '14 | '15 | '16 | '17 | '18 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| January | 169 | 169 | 234 | 346 | 357 | 160 | 359 | 334 | 345 | 276 | 314 | 298 | 267 | 349 | 343 | 212 |
| February | 201 | 133 | 289 | 317 | 332 | 168 | 428 | 337 | 272 | 313 | 335 | 313 | 301 | 320 | 324 | 173 |
| March | 416 | 317 | 522 | 494 | 510 | 279 | 616 | 609 | 510 | 497 | 467 | 547 | 464 | 549 | 495 | 190 |
| April | 328 | 396 | 495 | 617 | 673 | 422 | 714 | 614 | 543 | 650 | 548 | 489 | 499 | 563 | 476 | 286 |
| May | 343 | 333 | 461 | 530 | 632 | 355 | 662 | 518 | 427 | 594 | 506 | 506 | 531 | 673 | 412 | 259 |
| June | 310 | 399 | 546 | 543 | 555 | 464 | 621 | 501 | 564 | 576 | 490 | 519 | 402 | 636 | 368 | 243 |
| July | 282 | 358 | 461 | 491 | 456 | 422 | 607 | 433 | 499 | 483 | 444 | 506 | 405 | 880 | 340 | 246 |
| August | 266 | 313 | 485 | 478 | 387 | 338 | 489 | 426 | 631 | 520 | 393 | 342 | 448 | 393 | 290 | 225 |
| September | 189 | 355 | 463 | 439 | 336 | 365 | 487 | 414 | 466 | 368 | 391 | 339 | 435 | 400 | 292 | 185 |
| October | 246 | 312 | 377 | 458 | 378 | 473 | 418 | 419 | 407 | 411 | 366 | 311 | 438 | 583 | 235 | 118 |
| November | 207 | 309 | 381 | 397 | 231 | 446 | 381 | 428 | 379 | 385 | 295 | 218 | 419 | 425 | 248 | 81 |
| December | 182 | 258 | 292 | 339 | 217 | 341 | 372 | 365 | 336 | 468 | 438 | 237 | 443 | 442 | 170 | |

MONTHLY VALUES OF BUILDING PERMITS ISSUED FOR TWENTY LEADING CITIES
Original items in units of $100,000

and the ratio $\sigma/a'$ is small because of the initial restrictions imposed upon the series.

On the other hand it is clear that the values of $T$ may be closely alike or widely different, depending upon the form of the series. It is this fact which justifies the practical conclusion of Part I.

It has not been the purpose of this paper to secure greater refinement in the computation of the correlation coefficient for ordered series. Indeed, it is sought here to point out the lack of justification for as great refinement as is ordinarily used. The fact is that we are still far from our goal of securing a satisfactory index of the correspondence between two ordered series. It is worthy of note that in its magnificent work the Harvard Bureau uses the coefficient chiefly to determine the lag between two series. It has seemed advisable to work out the above relations; for, however uncertain is our knowledge of the exact portion of a particular variation in a historical series which is assignable to "secular growth," from a mathematical point of view the position of the line is one of the most precise things with which we deal. Further study of the line, as determined on this new principle, may increase our knowledge of the correlation between ordered series and point the way to a new method of separating out the "cyclical" portion of the variation in historical series, to examine which is usually our ultimate object.

# THE WORK OF DREYER IN RELATION TO LIFE INSURANCE EXAMINATIONS[1]

By Louis I. Dublin, *Metropolitan Life Insurance Company*

The subject, "The Assessment of Physical Fitness," commends itself especially to an audience of life insurance medical directors. For to assess physical fitness of applicants for insurance is exactly their function. One could hardly have hit upon a more apt title than has Dr. Georges Dreyer, of Oxford, for his recent book. When you pass upon an applicant for insurance, you assess his physical fitness on the basis of his structural and functional normality. You look for sound heart, lungs, and kidneys, for sound mind, and for evidence of normal health in the applicant's appearance and his ability to carry on his daily work. Recently, you have turned to such supplementary evidence of physical fitness as that afforded by the interrelationship of height and weight according to age. There are, of course, other items, such as occupation, habits, and the living conditions of the applicant, which assist in forming a judgment of what constitutes a standard risk. Your basic assumption is that every one of the points referred to has a definite and measurable effect on longevity, and that in their totality they give a fairly good guide for classifying applicants into those who will and those who will not measure up to the expectation of the mortality tables used as a basis for the calculation of premiums.

Dr. Dreyer is not concerned with life insurance examinations. He is interested primarily in developing a series of norms for distinguishing those who are physically fit from those who are not. These norms are based on the interrelationships existing between a limited number of bodily measurements, which are as follows: weight, height sitting or stem length, and circumference of chest and vital capacity as measured by the spirometer. These measurements, which are easily made, Dreyer believes give a clue to physical fitness. He has discovered, he says, the true relationships which exist between these four measurements in the healthy individual. By actually applying the normal relationships to individual cases, he thinks he can distinguish those who are physically fit from those who are not.

Dreyer expresses the relationships between the four measurements referred to in a series of simple formulas. Each one of these gives the value of one of the measurements in terms of one of the others. Thus, there are formulas which express the relationship between the weight and the stem length, between the weight and the chest girth, between the chest girth and the stem length, and between each one of these three measures and the vital capacity. These six formulas are applicable to persons up to age 50. There is a set for males and one for females, the two sexes being very different in the interrelationship of their measurements. To obviate calculations, the author in his book has appended a number of tables which express the values of these measurements in terms of each other. Thus, for each stem length in centimeters, a table gives the corresponding weight in kilograms; another table gives the weight corresponding to chest girth. It is possible from the tables to read off what all the measurements of a normal individual should be from any one of the four that may be given. There are two sets of tables for both males and females, one in the metric system, the other in the American or English system of weights and measures.

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[1] Read at the Annual Meeting of the Association of Life Insurance Medical Directors, October 20, 1921.

The writer desires to express his obligation to Professor C. C. Grove and Miss Margaret E. Gantt, of the Statistical Bureau, for their valuable assistance in the preparation of this paper.

Dreyer presents a number of apt illustrations which show concretely the uses of his tables. The problem is to determine whether or not an individual is physically fit according to his actual measurements. Given the four measurements, he finds first the expected weight from the stem length and also from the chest measurement. If these agree with the actual weight, the person has normal proportions. But in many instances he finds normal persons whose theoretical weights according to stem length and according to chest girth are different. In such cases he takes the average of the two theoretical weights and compares that average with the actual weight to determine the individual's fitness. If the individual has a normal weight, he then finds the theoretical vital capacity from the actual weight. He compares that figure with the actual vital capacity to determine the percentage deviation from the theoretical vital capacity. If an individual has a weight which is 5 per cent from the normal, he possibly has an abnormal weight; if he differs from the normal by as much as 10 per cent, he is probably abnormal with respect to weight; and if the deviation reaches as much as 15 per cent, his weight is certainly abnormal. Individuals may be abnormal as to weight and still be physically fit. If they are overweight and their vital capacity is commensurate with their added weight, they are considered physically fit because they have a larger vital capacity than would be expected from their stem length and chest. On the other hand, persons who are underweight for their stem length and chest may be physically fit if their vital capacity is commensurate with their stem length and chest. The following are two illustrations, the one being taken from Dreyer's examples of a person who is normal in all respects, and the other improvised to illustrate a person who is physically unfit according to the Dreyer standards:

### ILLUSTRATION 1[1]

Female, age 21 years

Observations

Weight of body = 62.0 kilograms
Length of trunk = 88.8 centimetres
Circumference of chest = 75.0 centimetres
Vital capacity = 3,630 cubic centimetres

Calculation

Weight derived from length of trunk (88.8 cm.) = 64.71 kilos (from Table VII).

Weight derived from circumference of chest (75.0 cm.) = 59.16 kilos (from Table VIII).

Averaging $\frac{64.71+59.16}{2}=61.9$ kilos, which is the normal weight corresponding to the observed length of trunk and circumference of chest.

Subtracting the calculated weight from the observed weight,

$$62.0-61.9=+0.1 \text{ kilos}$$

$$\frac{+0.1\times 100}{61.9}=+0.2\% \text{ (or roughly } 0\%\text{).}$$

Therefore the person weighs exactly what she should weigh according to the tables.

Since by the above calculation the person's weight is found to be normal, the vital capacity as calculated from the observed weight will be correct; therefore:

Vital capacity derived from weight of the body (62.0 kilos) = 3,556 cc. (from Table X, Class A).

Subtracting the calculated from the observed vital capacity,

$$3{,}630-3{,}556=+74 \text{ cc.}$$

$$\frac{+74\times 100}{3{,}556}=+2.08\% \text{ (or roughly } +2\%\text{).}$$

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[1] Taken from Georges Dreyer and George F. Hanson, *The Assessment of Physical Fitness*, American ed., Paul B. Hoeber, New York, 1921, p. 109.

Therefore the person has 2 per cent greater vital capacity than she should have according to the tables for Class A, calculated from the weight of the body.

### ILLUSTRATION 2

Male, age 25 years

Observations

Weight of body = 121 lb. 3 oz.
Length of trunk = $34\frac{7}{8}$ inches
Circumference of chest = $33\frac{1}{2}$ inches
Vital capacity = 3,272 ccm.

Calculation

Weight from stem length = 135.35 lb.
Weight from circumference of chest = 137.99 lb.
Averaging above weights = 136.67
∴ Person is 11.3 per cent underweight.

The vital capacity if obtained from the actual weight would be too low for the stem length and the chest girth. We therefore calculate the vital capacity from the stem length and the circumference of chest as follows:

Vital capacity from stem length = 4,061 cc.
Vital capacity from chest circumference = 4,118 cc.

The average is 4,090 cc.

The actual vital capacity is 20 per cent below normal by stem length and chest circumference.

This individual is, therefore, not in physically fit condition according to Dreyer.

These two illustrations show how Dreyer's tables may be used to discover individuals who are physically fit or are abnormal according to his standards. He is particularly convinced of the value of the vital capacity as an index of physique and health. By applying his values for vital capacity to the measurements of a large number of tuberculous patients, he has been able to determine the stage of tuberculosis, to give the prognosis in these cases, and to indicate the benefit derived from sanatorium treatment. He believes that his measures disclose the existence not only of tuberculosis but of other diseases as well. This phase of the work has been confirmed by a number of other observers for cases of tuberculosis and of heart disease.

Obviously, a work which promises to do all of this should be of the greatest interest to life insurance executives. For if we can through a series of simple measures really distinguish the fit from the unfit, we have made an important advance. But before we can accept as demonstrated so epoch-making a contribution we must be very sure that the premises are correct and that the conclusions are sound. Let us then see how nearly the conclusions of Dreyer are justified by the internal evidence presented, and to what extent the conclusions can be applied to the life insurance business. To evaluate the work of Dreyer it is necessary not only to read his book but to study very carefully a number of highly technical papers which he has issued from time to time. The most important of these papers appeared in the *Lancet*, August 9, 1919, and was entitled, "The Normal Vital Capacity in Man and Its Relation to the Size of the Body." In this paper he derives the various formulas which express the relationships existing between the four measurements already referred to. The relationships are worked out from the measurements of 16 males who ranged in age from 13 to 52 years and were selected for their physical fitness.

Strangely enough, Dreyer does not use the same formulas in his book as in his *Lancet* paper. The following parallel columns will show the differences:

COMPARISON OF FORMULAS FOR VARIOUS MEASUREMENTS FOR MALES[1]

[1] $W$=weight in grammes; $\lambda$=length of trunk in centimetres; $Ch$=circumference of chest in centimetres; $VC$=vital capacity in cubic centimetres.

| | Book | *Lancet* paper |
|---|---|---|
| (1) | $W = .38025\sqrt[.319]{\lambda}$ | $\lambda = \frac{W^{\frac{1}{3}}}{.449}$ or $W = .0905\sqrt[.33]{\lambda}$ |
| (2) | $W = .662\sqrt[.365]{Ch}$ | $Ch = \frac{W^{\frac{1}{3}}}{.457}$ or $W = .0954\sqrt[.33]{Ch}$ |
| (3) | $Ch = \frac{\lambda^{1.1442}}{2.00148}$ | not given |
| (4) | $VC = \frac{W^{.72}}{.69}$ | $VC = \frac{W^{.72}}{.69}$ |
| (5) | $VC = \frac{\lambda^{2.257}}{6.1172}$ | $VC = \frac{\lambda^2}{1.9}$ |
| (6) | $VC = \frac{Ch^{1.973}}{1.5595}$ | $VC = \frac{Ch^2}{1.82}$ |

Formulas (1) and (2) for males as given in the book are very unlike those in the *Lancet* paper. They are, moreover, not the ones from which the tables in the book were computed. As might be expected, they are not consistent with the other formulas. Number (1) should read $W = .0483\sqrt[.319]{\lambda}$, and number (2) should read $W = .3229\sqrt[.365]{Ch}$. With these corrections, the six formulas of the two series agree very closely even if they do not appear to on first inspection. There are similar discrepancies in the formulas presented for females. $W = .36093\sqrt[.313]{\lambda}$ should read $W = .03856\sqrt[.313]{\lambda}$, and $W = .30213\sqrt[.284]{Ch}$ should be $.01478\sqrt[.284]{Ch}$. Otherwise the formulas are consistent and are used in compiling the tables. It is difficult to understand how these errors have crept into the book. But they are there.

Let us now consider the set of formulas as corrected. Do they truly express the relationship between the various measurements that we are considering? To answer this question we attempted to derive the formulas independently. By the method of least squares we obtained a series of values which fitted the facts pretty well but which did not present so close a fit as the values obtained by Dreyer. We did not exactly duplicate any of the Dreyer formulas, although we could approximate a number of them on theoretical grounds. It must be admitted that his formulas fit the data for the 16 males better than any other values we could obtain. Let us examine some of these formulas separately.

$$VC = \frac{W^{0.72}}{0.69}$$

This formula is the most important in the series. On applying it to each one of the 16 individuals, we found only one whose actual vital capacity deviated considerably (+6.7%) from that predicted by the formula. But in view of the fact that an excess of vital capacity is a favorable feature, no fault can be found with the fit of the formula to these individuals. Similarly, Dreyer applied this formula to the material of Schuster, and he shows that the relationship between weight and vital capacity in this large group of Oxford undergraduates as a whole is in accordance with the formula.

We have in like manner attempted to apply this Dreyer formula to a group of Harvard undergraduates[1] and have found that these boys, with few exceptions, had a higher vital capacity than that predicted by the formula according to their weights. This finding does not in itself impair the value of the formula, because, as Dreyer says, the vital capacities he has given are averages for fit individuals and may be exceeded by highly developed and athletic persons.

[1] West, "Clinical Studies on the Respiration," Arch. of Int. Med., vol. 25, p. 306.

His other formulas are not quite so fortunate. Let us take the one expressing vital capacity in terms of stem length. The formula is:

$$VC=\frac{\lambda^2}{1.9} \text{ or } \frac{\lambda^{2.257}}{6.1172}.$$

When applied to his 16 individuals, we find that one person, No. 12, has a vital capacity which is 20 per cent in excess of that predicted, whereas No. 16 is 13 per cent below. There are altogether 6 individuals whose vital capacity is at least 7.85 per cent above or below the normal. If we use the formula given above (used in his book) we find that there are 6 individuals whose vital capacity is at least 6 per cent above or below the expected. These are presumably fit persons, and since there are 2 individuals out of 16 who are seriously below the expectation, it would seem either that there is something wrong with the formula as an expression of fitness or that there are wide limits between which fit individuals can be found. These deviations from normal vital capacity are almost as marked as are those calculated from height standing according to Hutchinson's method, which Dreyer insists has no value.

Nevertheless he places great confidence in this expression for vital capacity and height sitting and prefers it even to the previous formula showing vital capacity in relation to weight, because, as he points out, weight may change rapidly but stem length does not.

Likewise his formula for vital capacity and chest,

$$VC=\frac{Ch^2}{1.82} \text{ or } \frac{Ch^{1.973}}{1.5595},$$

shows a considerable range of deviation for his 16 individuals. There are 5 persons in his series who are all the way from 6 to 10 per cent below the expected vital capacity. Yet he insists that the vital capacity of fit persons must not fall so much as 10 per cent below the normal. Following out his own procedure we averaged the calculated vital capacities as obtained from both stem length and from chest. We found by this method that of the 16 persons specially chosen for their physical fitness, 3 had a vital capacity 7 per cent or more below the normal. One of these, No. 16, is 8.8 per cent below, which is close to the limit for "probably" unfit individuals according to Dreyer's standards. This same individual is 7.7 per cent underweight for his stem length and chest girth, and 3.1 per cent under vital capacity even for his underweight.

There is another line of evidence that all is not well with these formulas. Take, for example, the relation between weight and stem length and weight and chest. Dreyer, equating the two formulas, concludes that "in the normal healthy man the circumference of the chest is, on the average, about 1.5 per cent smaller than the stem length, though in a fair number of the individual cases the chest measurement may be greater than the stem length." On applying this test to his own series we find that 4 out of the 16 individuals have chest girths 4.5 to 6.2 per cent greater than their stem length, and 4 more have chest girths from 5.5 to 10.1 per cent less than their stem length. There is, obviously, too much variation to satisfy the rigid expressions laid down by Dreyer. The conclusion drawn from these several discrepancies is that Dreyer attaches more value to his formulas than is justified by the facts. The proper relationship between the several measures must be expressed in terms of a measure of correlation with limits between which the variables may fluctuate.

So far we have referred to the formulas for males only. One half of Dreyer's book is given over to tables for females which show the relationships existing between the four measurements heretofore discussed. These tables are constructed on the basis of formulas similar to those for males. But nowhere does Dreyer give us any clue as to how these formulas were obtained, how many lives they were based upon, and whether they have been confirmed by others. In fact, they are interjected into the book without any explanation. I have already called your attention to errors in the two basic formulas for weight in terms of stem length and chest. But even a very cursory examination of the tables and the formulas shows that they are inconsistent with some of the well-known facts with reference to the relation of build of women to that of men. For example, Dreyer's tables show that for the same stem length or height sitting, women are heavier than men. For a height sitting of 35 inches, a male according to Dreyer should weigh 137 pounds and a female, 143 pounds; that is, a female is about 5 per cent heavier. But we know that for the same height standing, females are a little lighter than males. The anthropologists tell us that females have a relatively greater height sitting than males. Therefore it would follow that for the same height standing, females would be lighter according to our standard tables of height and weight, whereas they would have longer stem lengths and, therefore, appreciably greater weight than the males according to the Dreyer tables which are correct. The discrepancy is really very considerable, and I am inclined to say that for the present at least no use can be made of that section of Dreyer's book which relates to females.

The important question for us today is what use we can make of the Dreyer work. I will say frankly that as yet its use is very limited.

The Dreyer researches are still in an experimental stage. We should hesitate to apply to practical business affairs standards which are likely to be greatly changed when derived from the measurements of larger groups of people whose physical condition is more definitely known than was the physical condition of the group reported upon by Dreyer.

But quite apart from the accuracy of the formulas, there is the fundamental question as to their significance. Dreyer insists that they express the relationship between the various measurements in physically fit people, and that they can be used to distinguish between those that are physically fit and those that are not. Unfortunately, this is the weakest spot in the entire work. For what is meant by "physical fitness"? If this is an expression merely of the general vigor of an individual or of individuals as determined by their appearance, then, obviously, there is little value for us in the characterization. We know only too well that individuals of good general appearance may on careful examination be found to be suffering from serious physical defects. If we assume that the 16 persons who made up Dreyer's series and the other groups which also confirm his findings were persons who on actual physical examination were found to be free from organic disease, then we have a better basis. But even then the applicability of the work to insurance must be limited. For in the last analysis the insurance examiner is concerned with fitness in the sense of the ability to live. This is the one test of physical fitness which insurance constantly has in mind. In this sense physical vigor is not the only consideration. Personal history, habits, and a host of other items enter as determinants of longevity. "Physical fitness" and "longevity" are far from synonymous. We know that certain races are notoriously long-lived, but are not physically well developed; that females have greater longevity but poorer physique than males, and that certain occupations, especially where the work is sedentary, lead to the development of poor physique, but do not necessarily involve a short life span for the workers.

It must be clear, therefore, that from the insurance standpoint the Dreyer work is at its inception. What is necessary for us is a series of measures of the Dreyer type which are definitely known to express relationships among individuals who correspond in insurance language to standard lives. We must avoid loose or vague expressions. By standard lives, as opposed to the physically fit, we mean individuals who will give a subsequent mortality corresponding to our usual tables. With reference to Dreyer's fit persons we can say nothing as yet. The problem then resolves itself into tracing the subsequent mortality of various groups of individuals whose relative indexes are known. We shall in that way build up a fund of information which is likely to be very useful to us.

Yet the work is very suggestive, and it would be entirely unfair to leave the impression that there is no utility for us in Dreyer's studies. He has opened up a wide field for further investigation. The most fruitful contribution for insurance purposes is likely to come out of a revision of the indexes giving the relationship between height sitting, chest girth, and weight. We shall have to forego the idea of perfect correlation between these three measurements and attempt rather to find the limits of their variability among standard lives. A series of tables should be prepared showing, for example, the distribution of weights for each inch of height sitting and the mortality experience of each combination. A similar table for chest girth and weight would be needed. Research might show that the best results for insurance work follow from a combination of chest girth and height sitting in relation to weight. Such tables will agree better with the known facts of human variability than do Dreyer's rigid formulas which leave, theoretically at least, little or no room for variation from the type.

The height and weight tables we now use in insurance work illustrate the other extreme, that is, much variability of weight with reference to total height. For the weights for any given height may vary enormously from the average. In height and weight relationships there is a very wide range instead of concentration at the average. Furthermore, mortality is apparently not seriously affected by this extreme range of variability, for individuals may be as much as 30 or even 40 per cent below the average and still enjoy standard mortality. For underweights, at least, our height and weight tables have apparently little value. The coefficient of correlation between total height, weight, and mortality is too low to give useful indexes for insurance purposes. It is because of this defect in the height and weight tables that Dreyer's alternative measurements for height sitting, chest girth, and weight may prove of the greatest value. These three measurements are much more closely correlated than are height standing and weight. The limits of variability will be found to be much less. It is only necessary to identify the various combinations with the facts of mortality. This has not yet been done. It is the chief suggestion that arises out of the consideration of Dreyer's work. For it is possible that when further investigation is carried out, we shall have guides as to build which will be very much better than the height and weight relationships we now use.

The relationship of vital capacity to weight, although probably the most accurate in the whole series presented by Dreyer, is one which unfortunately is not adapted to the insurance business on a large scale. Spirometer readings can be very much modified through exercise, and it would be entirely possible for an applicant with a low spirometer reading to increase his vital capacity very appreciably through exercise and practice without materially improving his health. Spirometers are rarely, if ever, found in physicians' offices, and the use of this rather expensive instrument must be limited to laboratories. It is conceivable, however, that the method may be useful in clearing up some doubtful cases in which the build of the applicant suggests defects which are not proved on the examination. Take, for example, an applicant who is overweight 30 per cent and who otherwise presents a good picture of physical health. According to present practice we should be suspicious of him, especially if the amount of insurance were considerable. Our practice would be to reject him or to offer him sub-standard plans. But suppose the individual has the predicted weight for his stem length and chest measure and the normal vital capacity for his weight. It is then probable that such a person would prove a much better risk than the applicant who was overweight for his other proportions and whose vital capacity was too low for his extra weight.

It is possible, however, that the relationships between vital capacity and the other measurements may prove useful in singling out cases of incipient tuberculosis. Dreyer's work seems to indicate that there is a much lower vital capacity among persons in that condition. The Dreyer measures might serve as one more guide in forming a judgment on such applicants. In the same way, the Dreyer measures for vital capacity when applied to cases of arrested tuberculosis might very well indicate which were the safest risks.

But the chief value to us in Dreyer's work lies in the future. He has opened up an obviously rich field for further investigation. It may well be that the insurance companies are the best agencies for revising his formulas and for adding to their value. For such units as they will prepare will measure the very definite character of longevity rather than the vague condition of physical fitness. I am inclined to believe that many contributions will be made at the future meetings of this association by members engaged in revising and refining the very fertile work of our author.

# CYCLES OF EMPLOYMENT AND UNEMPLOYMENT IN THE UNITED STATES, 1903-1914

By W. A. **Berridge**, *Harvard University*

In the first of these articles on employment and the business cycle,[1] a current index of employment in the United States was proposed, extending from the outbreak of the war to date. A half-dozen or more employment and unemployment series were examined, but only two were found to have all the characteristics naturally expected of a reliable current index. Accordingly, a combination of these two—properly corrected for seasonal variation, etc.—was proposed as a good index for present use, extending back far enough into the past to afford an adequate basis for the interpretation of current fluctuations. These two series were found to be strongly supported by the others. The high order of correspondence is shown by the correlation coefficients: the United States Bureau of Labor Statistics with the New York State Industrial Commission series (1915–21) +95 per cent; an adjusted combination of these two, with the Wisconsin series (1915–21) +98 per cent; the adjusted combination, with the Massachusetts employment series (1914–20) +80 per cent; adjusted series representing Massachusetts employment and unemployment (1914–20) −89 per cent.[2] The general employment index was found to bear striking relationships to military mobilization and demobilization, and to Day's monthly index of the production of manufactures, corrected for the varying length of month. The correlation between industrial employment and production was found to be 96 per cent.[3]

The purpose of this second article is: (1) to present an index of employment applicable to general industrial conditions in this country in the ten or fifteen years before the war; (2) to check up this index with the United States Censuses of Manufactures; and (3) to compare employment with direct measures of production before the war. The method utilized is, as before, the index method, without reference to that somewhat illusory concept, "the quantity of unemployment."

The two best employment series now current are of no assistance in studying pre-war relationships, not having been begun until early in

[1] This Journal, vol. XVIII, pp. 42–55, Mar., 1922.

[2] Coefficients were not computed for the shorter series, such as that of the U. S. Employment Service.

[3] Since the writing of the first article, in January, Professor Day has tentatively estimated and eliminated the seasonal variation of his production series. His new results, compared with the adjusted employment index, appear in the *Harvard Economic Service*, vol. I, p. 73, *Weekly Letter* no. 13, Mar. 25, 1922. The correlation with his new series is also 96 per cent.

the war. Three other bodies of evidence are available which are similar in their nature, relating to the numbers employed in manufacturing establishments. These have been collected by the United States Census of Manufactures and by the state bureaus of statistics in New Jersey and Massachusetts. Furthermore, two unemployment series collected by the state bureaus in New York and Massachusetts are of assistance in constructing a general pre-war index of employment. Our first task is a critical review of these five bodies of evidence.

### DIRECT MEASURES OF EMPLOYMENT

Employment data for Massachusetts.—Since 1889 the Massachusetts Bureau of Statistics has collected, early in each year, data showing the number of wage-earners on pay-rolls at the middle of each month during the preceding year in the most important manufacturing establishments of the state. The results have been published in the *Annual Reports on the Statistics of Manufactures*.[1] The aggregate number of wage-earners covered by these reports has ranged from 150,000 to 800,000. Although the data are very comprehensive they have not remained equally so throughout the period. Thus in 1899 about 360,000, or 82 per cent of the 438,000 wage-earners shown by the United States Census for Massachusetts, were covered by the reports of the state bureau; by 1904 the number had risen to 430,000 or 88 per cent, and in recent years it has become even larger.[2]

An important peculiarity of manufacturing in Massachusetts is the degree of industrial specialization, particularly in the manufacture of cotton goods. Cotton manufacturing forms between 16 and 26 per cent of the total manufacturing in the state, as contrasted with the figure of 6 per cent representing the quota of the cotton industry in the entire country. In other words, about 30 per cent of the country's cotton manufacturing is carried on in Massachusetts.[3] The boot and shoe industry also ranks high, constituting 10 to 16 per cent. Woolen and worsted goods, and foundry and machine-shop products, are groups of about equal importance, each employing 7 to 12 per cent of the total number of wage-earners. These four industrial groups comprise 40 to 55 per cent of all manufacturing in Massachusetts. Industrial specialization is one factor which renders the Massachusetts returns imperfectly representative of general industrial conditions. Moreover,

[1] The figures for 1919 and 1920 were kindly supplied by Mr. Roswell F. Phelps, Director of the Bureau. Those for 1921 have not yet been tabulated.

[2] It is impossible to determine precisely the degree of inclusiveness after 1904, because in the subsequent census years the Bureau adopted outright the federal bureau's figures for Massachusetts; but the percentage appears to have risen decisively, perhaps to 95 per cent or even higher.

[3] Compare U. S. Census of Manufactures, 1914, *Abstract*, pp. 29–56, and the *Annual Report* of the Massachusetts Bureau, 1914, p. 52.

cotton manufacture, the most important of all, is wholly dependent upon agriculture for its raw material. This is another disadvantage, because an especially large or an especially small cotton crop seriously affects the response of this industry (and therefore the aggregates for Massachusetts) to the business cycle.[1]

Another objection to the Massachusetts data lies in their discontinuity during the past sixteen years. Prior to 1906 the data published yearly covered identical establishments over a period of twenty-four months, so that the actual degree of change in these establishments between each December and the following January could readily be ascertained. This policy of "overlapping" the yearly reports was not maintained after 1906, and consequently the problem of building up a reliable continuous series is not an easy one. After 1906 the data do not form a true statistical series at all, but a series of floating fragments, unconnected with each other. As a local census of manufactures, year by year, these Massachusetts data are excellent; but as a continuous record of employment fluctuation they cannot safely be accepted without reservations.

Employment data for New Jersey.—From 1895 through 1918, the New Jersey Bureau of Industrial Statistics collected data very similar to the Massachusetts data, publishing them in its *Annual Reports*.[2] The scope of the materials, limited to about 50,000 wage-earners in 1895–97, was considerably enlarged in subsequent years, ranging from 140,000 in 1898 to 320,000 in 1914.[3] Here as in Massachusetts the canvass did not cover a fixed proportion of establishments, nor even a steadily increasing proportion. Thus, in 1899 an average of 175,000 wage-earners was represented, *i. e.*, 82 per cent of the number shown by the federal census of manufactures; the ratio fell to 77 per cent in 1904, then rose to 87 per cent in 1909, and 88 per cent in 1914. New Jersey, unlike Massachusetts, is industrially diversified: the machinery and metal-working industries are fairly strong, as is natural in a state situated so near to iron and coal resources; but silk, wool, tobacco, and several others also rank comparatively high. It is noteworthy that cotton ranks eleventh, representing only about 2 per cent of all New Jersey's manufacturing.

[1] Another disadvantage is the importance of women workers in the industries of Massachusetts—about 40 per cent in cotton goods, 32 per cent in boots and shoes and in woolen and worsted goods, and 25 per cent in paper manufacture. The employment of juveniles, to the extent of about one eighth of the grand total, also makes the returns less reliable than if they related solely to adult male breadwinners.

[2] The data for the years 1895–1916 were obtained from these reports. Those for 1917 and 1918 were made available through the courtesy of Mr. J. A. T. Gribbin of the Bureau. The series was discontinued in 1918, though of course the federal census will presently show 1919 data for New Jersey.

[3] The number rose rapidly during the war to a half-million and more, owing chiefly to the growth in the manufacture of munitions, explosives, and chemicals in that state.

Census data on employment.—Monthly figures of a nature similar to the two sets just described are available also for the United States as a whole, but only for the quinquennial census years. Despite their disconnected character they have seemed worthy of analysis, since they cover 5,000,000 to 9,000,000 workers and offer promise as supporting evidence. The first monthly data available from this source were collected in 1899, but unlike the subsequent censuses this first set included hand trades and neighborhood industries, and have never been corrected on a basis comparable with the others.[1]

The essential homogeneity of the census data after the 1899 Census may be seen in the figures showing industrial composition.[2] The most important industrial group in the country as a whole is the combination of textiles and their products, which form about 21 per cent of the total, as measured by the number of wage-earners. The second in order of rank among the fourteen standard groups is iron and steel, which alone forms about one sixth of the aggregate and when combined with the three kindred groups—railroad repair shops, vehicles for land transportation, and metals and metal products other than iron and steel—forms a quota considerably more than one fourth. Lumber comprises about one eighth, and several other groups—namely, food and kindred products, paper and printing, and stone, clay, and glass products—4 to 7 per cent each. Each of these industries has maintained its quota in a fairly stable manner throughout the period 1899–1914. In not more than two or three cases (vehicles for land transportation, railroad repair shops, and the miscellaneous group) has there been any appreciable increase, while in only two cases (lumber and its products, and leather and its products) has there been a decline. In all the other groups, quotas have remained practically constant.[3] The industrial distribution has clearly remained sufficiently stable from census to census to justify regarding the data as industrially homogeneous.

## PRELIMINARY ANALYSIS OF EMPLOYMENT DATA

In the first method of analyzing these three groups of employment data, no assumption whatever was made as to the change between years; the data were regarded as reliably measuring only the course of developments *within* a calendar year. The effects of seasonal variation and of secular trend were eliminated as well as possible by a special method, in such a way as to show the status of the employment cycle in any month as compared with January of the current year. This method involved four steps, the first two of which are suggested by Persons' analysis of seasonal variation in *continuous* series. The procedure involved: (1) computing the month-to-month link relatives, except, of course, for $\left(\frac{\text{January}}{\text{December}}\right)$; (2) taking the median of all the $\left(\frac{\text{February}}{\text{January}}\right)$ links as indicating the normal combined influence of seasonal variation and secular trend between January and February, and correspondingly the median for $\left(\frac{\text{March}}{\text{February}}\right)$, etc.; (3) subtracting from each actual link relative the corresponding median, yielding a percentage which should indicate the net effect of the business cycle between the two months; (4) finally, compounding the links into chain relatives with January of the current year as 100 per cent.

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[1] See the *Abstract of Manufactures*, 1914, p. 435. Although the Census Bureau appears to have revised its "representative date" figures to exclude these extraneous industries, the monthly data have never been so re-worked. It is understood that the Bureau, under the direction of Dr. Leo Wolman, is now planning to make such a re-computation.

[2] *Abstract of Manufactures*, 1914, p. 29.

[3] No data on the industrial distribution at the census of 1919 are yet available.

This method was first applied to the Massachusetts and the New Jersey data, yielding a series of fragments, one for each year. As an experiment, the method was also applied tentatively to the census data, though without great hope of success, because the sets of link relatives available for determining the normal month-to-month movements numbered only three. The 1919 data had not become available, and, as already explained, those for 1899 were not comparable; only those for 1904, 1909, and 1919 were available for use.

The need of relying upon three link relatives for determining the median did not result in such great inaccuracy as had been expected. In order to show the probable reliability of this rough method, experiments were made with the median link relatives, based first upon the eleven years 1903–13 and then upon the three census years for comparison. These sets of *median* link relatives were then joined together with January as 100. An illustration of the result is shown in Chart 1; the curves represent the normal effects of seasonal variation combined with secular trend on the New Jersey data. These experiments indicated that the median of three links is not hopelessly inaccurate; indeed it appears to be fairly reliable as a first approximation to the normal movements within the year. Accordingly, this method was applied to the census data for all states and all industries combined, and the resulting fragments compared with those derived from the state data for New Jersey and Massachusetts. Chart 2 shows these results for the census years.[1]

After the elimination of trend and seasonal variation, the cyclical elements present in the three sets of employment data are found strikingly similar. In amplitude, as in form, the three indexes agree

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[1] The recently tabulated data for 1919 have just been placed in the writer's hands through the courtesy of Dr. Joseph A. Hill, Assistant Director of the Census.

CHART 1
GENERAL EFFECT OF SEASONAL VARIATION AND LONG-TIME TREND COMBINED, ON EMPLOYMENT IN NEW JERSEY
(JANUARY · 100 PERCENT)

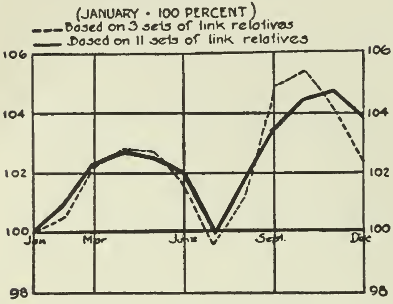


CHART 2
FRAGMENTS OF EMPLOYMENT CYCLES DURING CENSUS YEARS
(JANUARY OF CURRENT YEAR · 100 percent)

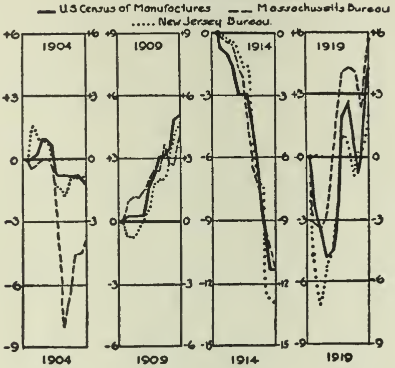
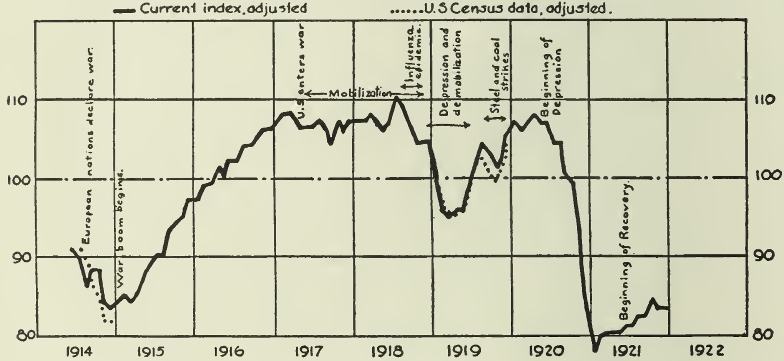


CHART 3
CURRENT EMPLOYMENT INDEX COMPARED WITH UNITED STATES CENSUS DATA
(UNIT: ONE PERCENT)



very well in the three later years, though less well in 1904. In 1909 all three rose about 5 per cent above the January base; in 1914 all three fell between 10 and 12 per cent; and in 1919, the depression just after the Armistice, the subsequent recovery, and, in the last quarter, the steel and coal strikes, appear unmistakably in all three curves.

The erratic behavior of the employment indexes in 1904 is not a feature peculiar to themselves, but is found also in other industrial barometers, such as pig iron production. Study of the various trade papers in 1904 also indicates clearly that after the "rich men's panic" of 1903 two recoveries occurred in succession. The first, an abortive one, took place in the first half of the year, and was followed by a distinct slump. Then came the much more substantial recovery, beginning late in 1904 and continuing for two years or more. This reflex action seems to stand unparalleled in the annals of American business. It is not unnatural that some dissimilarities of behavior should appear in a year characterized by such reversals of the industrial machine. The three indexes differ chiefly in their verdict as to the severity of the intervening relapse. Apparently it was felt more severely and was followed by a slower recovery in Massachusetts than in either New Jersey or the United States as a whole.[1]

The new 1919 Census returns enable us to check up the corrected post-war index presented in the March JOURNAL.[2] The current index covers only about $1\frac{1}{4}$ millions, the census 9 millions of wage-earners; but the two when corrected for seasonal variation show a correlation of 97 per cent. The curves in Chart 3, as in the one representing pre-war results, manifest a strong similarity in both form and amplitude. This evidence goes far to support the current index as a trustworthy barometer of current industrial employment.

### FORMATION OF CONTINUOUS EMPLOYMENT INDEXES

The strikingly clear and decisive form of these cyclical fragments naturally raises the question whether any hypothesis can be applied which will make possible some form of adjustment that will enable one to join the fragments together in a continuous record of employment cycles in Massachusetts and New Jersey. Of the several hypotheses which have been tested, the best involves: (1) adoption of the data of the United States Census of Manufactures for Massachusetts and for New Jersey, as "abutments" upon which to adjust the respective state bureaus' data; (2) complete reliance upon the state bureaus' data as to the percentage changes in employment during each intercensal calendar year; and (3) the adoption of a standard or normal link relative to connect each December to the following January, on the assumption that the business cycle could be considered momentarily inoperative. The entire twelve-item fragment for each intercensal year was "stepped up" by such a percentage as to establish between each December and the following January this standard relationship.[3] Having thus interpolated the probable course of actual employment fluctuation between census years in these two states, the long-time trend, seasonal variation, and standard deviation were eliminated by an adaptation of the method devised by Professor Warren M. Persons,[1] yielding corrected cycles.

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[1] The same method of analysis, applied to the census data for the dozen leading industrial states separately, shows that none was affected as was Massachusetts.

[2] First proposed by the writer in the *Special Letter* of Oct. 8, 1821, Harvard Economic Service.

[3] Two kinds of standard $\left(\frac{\text{January}}{\text{December}}\right)$ link relatives were utilized: (a) such a percentage as would precisely account for the residual fluctuation between consecutive census years, not accounted for by the course of the state bureaus' data *within* the intercensal years; also (b) the median of the known $\left(\frac{\text{January}}{\text{December}}\right)$ links for the period 1889–1906. The first of these is to be preferred, owing to changes in the degree of inclusiveness and in the slope of trend of the latter. Either method may lead to inaccuracy in determining any single transition between years, but on the average its results are not likely

This method was applied to the Massachusetts data, first for cotton, then for all industries except cotton; the two resulting sets of cycles were combined on the basis of the relative importance of cotton manufacturing *in the entire country.* The same method was applied to all industries combined in New Jersey. Both curves are shown in Chart 4. Though derived wholly independently of each other, the results show a close correspondence; the correlation coefficient is 82 per cent. The only discrepancies are found in the abnormal year 1904, already discussed, and in such years as 1912 and 1913, when labor disputes in one state or the other caused temporary relapses.[2] In 1910 employment in Massachusetts was influenced both by labor disputes and by a short crop of cotton in the preceding year. With these minor exceptions, every important movement appears with almost equal clearness in the two indexes: the minor boom preceding the "rich men's panic" of 1903; the depression of 1904; the recovery and boom in 1905 and 1906; the relapse begun in July, 1907, and greatly accentuated by the panic of October–November; the beginning of recovery in June, 1908; the appearance and disappearance of the minor depression in 1910–11; the recovery in 1911–12; and the incipient depression of early 1913, continuing until after the outbreak of the war.[3]

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to be greatly in error; moreover, the use of the standard deviation (after Persons) lessens still further the chance of error in the final cycles.

In the view of the present writer such a method seems far superior to the use of external evidence for combining these fragments. It is possible but undesirable to resort to other data. In the first place, no continuous data actually measuring employment were available before the war, and it is hazardous to translate absolute changes in the continuous unemployment data into employment. Even if this be done in a reliable manner, it introduces a spurious similarity between the adjusted series and the reference series. Any comparison among the results would, in short, be fallacious, *i. e.*, it would involve reasoning in a circle. The same objection of course holds against the use of production data or other business indexes in lieu of employment as the basis for estimating December-to-January changes in employment.

For a different view of this whole matter, see Ralph G. Hurlin, "Three Decades of Employment Fluctuation," *The Annalist*, vol. 18, pp. 387–88, October 24, 1921.

[1] For Persons' explanation of his method, see *Rev. of Econ. Statis.*, prel. vol. 1, pp. 4–205, Jan. and Apr., 1919. The slight change made by the writer in the seasonal analysis was the use of an arithmetic rather than a geometric law for eliminating the secondary effect of trend from the seasonal chain relatives. The straight-line law simplifies the computation, and is also more in harmony with the general principle of using a straight line in measuring the long-time trend itself—a principle which Persons himself utilizes in that connection.

[2] Especially the great silk strike in Paterson, N. J., February–July, 1913.

[3] The end of depression in the winter of 1914–15 also appeared simultaneously in the two states. *Cf.* this JOURNAL, vol. XVIII, pp. 45, 50, Mar., 1922.

## MEASURES OF UNEMPLOYMENT

Even more valuable evidence as to employment fluctuations can be obtained by examining the fluctuations in unemployment, "the other side of the shield." Before the war two unemployment series were available, one for Massachusetts and one for New York state. Each was reported in consistent form, without sudden changes from year to year as in the pay-roll data; consequently they had in common the important advantage of continuity. They are also broader in industrial scope, comprising not only manufacturing but also building, transportation, etc. Both of the unemployment series are valuable, but that for New York has a net advantage, being reported monthly rather than quarterly, extending over a pre-war period twice as long as that for Massachusetts, and covering a much more important and more favorably situated industrial state.[1]

It is of course impossible to utilize these figures in their original form,[2] owing especially to the effects of labor disputes, seasonal variation, and long-time trend, as well as the very important changes in industrial composition. Suitable analysis has eliminated these difficulties,[3] yielding the two unemployment indexes shown in Chart 5. The results are in close accord with each other, and with the adjusted pay-roll data.[4] The correlation coefficients are as follows: between the two unemployment indexes, +72 per cent; between New York unemployment and New Jersey employment, −73 per cent; between New York unemployment and Massachusetts employment, −80 per cent; between Massachusetts employment and unemployment, −88 per cent.

## A GENERAL INDEX OF EMPLOYMENT AND UNEMPLOYMENT

We now have before us all the materials necessary for constructing a general index of employment cycles for the United States. The three states represented in Charts 4 and 5 comprise more than one fourth of all the industrial wage-earners in the United States.[5] The indexes appear to represent adequately the course of employment in the respective states. Although constructed entirely without reference

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[1] This Journal, vol. XVIII, pp. 43–44.

[2] Compare Chart 4 with the charts of original items for these two series, shown by E. S. Bradford, "Methods Used in Measuring Unemployment," Quar. Pub. of the Amer. Stat. Ass'n, vol. XVII, pp. 991–93, Dec., 1921.

[3] The methods of analysis are fully described in *Rev. of Econ. Statis.*, prel. vol. 4, pp. 26–34, Jan., 1922.

[4] The discrepancy in 1904 is due to the facts already pointed out. The slightly earlier increase of unemployment in New York in 1907 is also attributable to business conditions, not to any peculiarity in the unemployment curve as such. Bank clearings in cities of New York state outside the metropolis follow in 1907 the same course as the inverted unemployment curve.

[5] New York, 15 per cent; Massachusetts, 8; and New Jersey, 5; a total of 28 per cent.

CHART 4

EMPLOYMENT IN MASSACHUSETTS AND NEW JERSEY
(MONTHLY CYCLES: UNIT ONE STANDARD DEVIATION)

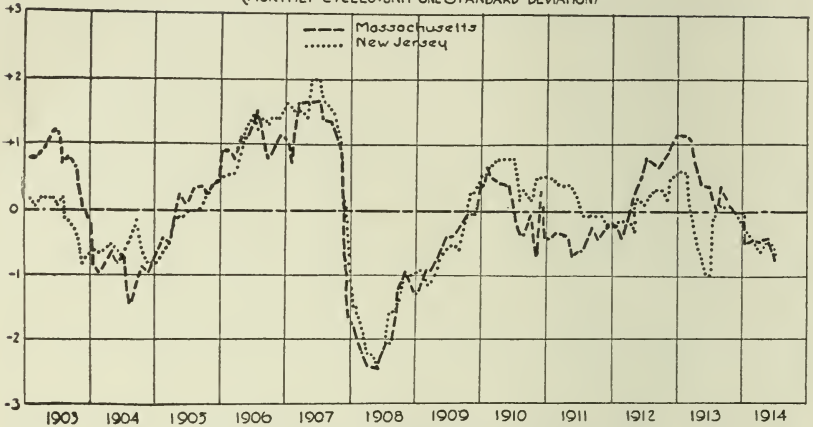


CHART 5

UNEMPLOYMENT IN NEW YORK STATE AND MASSACHUSETTS
(UNIT : ONE STANDARD DEVIATION)

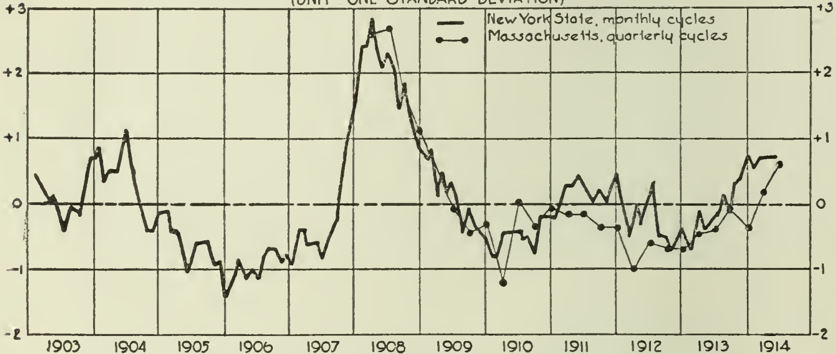
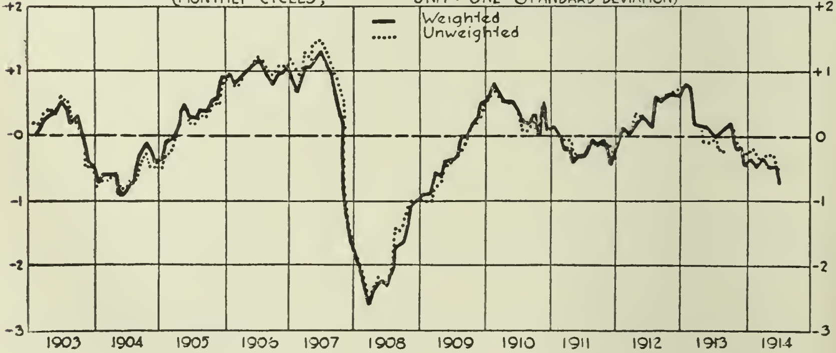


CHART 6

TWO COMBINATIONS OF EMPLOYMENT AND INVERTED UNEMPLOYMENT ( 3 STATES)
(MONTHLY CYCLES; UNIT: ONE STANDARD DEVIATION)



to one another, they support one another so thoroughly as to justify beyond any reasonable doubt a combination of the three.

Two such combinations[1] are presented in Chart 6. Both are based upon the two employment indexes and the New York unemployment index; the Massachusetts unemployment index, being quarterly, could not well be utilized in a monthly composite. In the weighted index the three components are assigned weights of five points (New York), three points (Massachusetts), and two points (New Jersey), proportional to the actual industrial importance of the three states, without penalizing the New Jersey and the Massachusetts data for their statistical and economic imperfections. If these be considered serious enough to justify reducing the two minor weights further, the combination would of course more closely resemble the inverse of the New York curve shown in Chart 5. Indeed, the reader who prefers to follow a strictly conservative policy may prefer to rely on the inverted New York index alone.[2] The question of weighting is, however, of slight importance in this case, owing to the similarity of the components. As a test of this, a simple average of the three has been constructed; this practically coincides with the 5–3–2 combination, as shown in Chart 6, giving a correlation coefficient of 99 per cent. The correlation between the unweighted combination and New York unemployment (inverted) is 94 per cent.

The continuous index of employment is strongly confirmed by the United States Census of Manufactures, before as well as since the war. Except in the industrially disordered year of 1904, the correlation coefficients have been consistently above 90 per cent—in 1909, 94 per cent, and in 1914, over 99 per cent. The post-war index has already been shown to have a correlation of 97 per cent. with the 1919 census.[3]

## EMPLOYMENT AS AN INDEX OF INDUSTRIAL ACTIVITY; OTHER USES

Chart 7 shows an annual index, likewise constructed by weighting the New York, Massachusetts, and New Jersey data, on the 5–3–2 basis.[4]

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[1] An earlier index has also been prepared, but it is omitted. It extends back to 1889, being based on the Massachusetts data alone until 1895, and on Massachusetts and New Jersey data between 1895 and 1902.

[2] See, for example, the *Rev. of Econ. Statis.*, prel. vol. 4, pp. 33–39, Jan., 1922. The weighted combination is presented in the table accompanying this article.

[3] *Supra*, p. 233. For the 1914 correlation the pre-war index was extended from June through December.

[4] Here the Massachusetts component for the years 1908–13 was obtained by taking the average of the employment and the reversed unemployment figures. To center the average of the quarterly unemployment cycles in the middle of the calendar year, a five-quarter rather than a four-quarter average was used: Dec. 31 of the previous year, and Jan. 31, Mar. 31, Sept. 30, and Dec. 31 of the current year.

The New York unemployment data are based upon the reports of all the unions in the state, rather than the representative selection (one-fourth to one-third as great) embodied in the monthly data. See *Rev. of Econ. Statis.*, prel. vol. 4, pp. 23, 24, Jan., 1922.

The curve is extended back to 1899, and is shown for comparison with Day's production index for all manufacture.[1] The correlation is extraordinarily close, being represented by a coefficient of 86 per cent.

CHART 7
INDUSTRIAL EMPLOYMENT AND PRODUCTION
(ANNUAL CYCLES; UNIT ONE STANDARD DEVIATION)

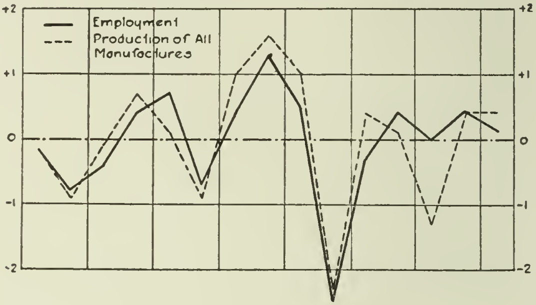
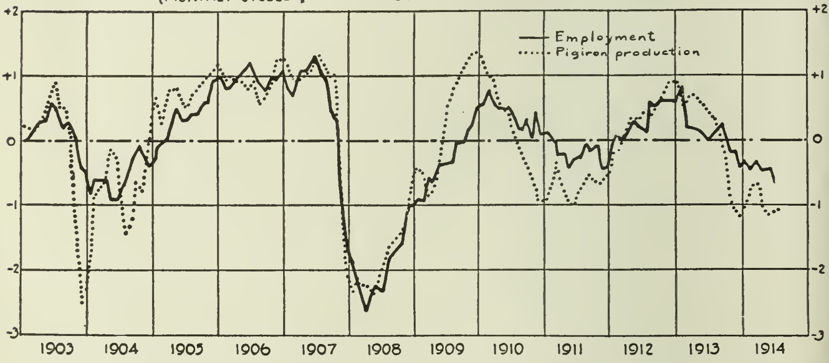


CHART 8
EMPLOYMENT AND PIGIRON PRODUCTION
(MONTHLY CYCLES ; UNIT - ONE STANDARD DEVIATION)



This agreement, close despite the differences in the source and the nature of the two groups of data, suggests the possibility of utilizing employment as an index of monthly production cycles prior to the war. Chart 8 shows the monthly index of employment, compared with pig iron production.[2] Here, again, the agreement is very close (89 per cent). In monthly form very few production series other than that for pig iron were available prior to the war, so that employment provides a much more comprehensive basis for picturing the monthly pre-war cycles of industrial production than can be obtained from direct evidence. The employment index covers not only a much wider variety of lines, but many more advanced stages of fabrication than could be represented in an index based on production data. Further substantiation is found in the relation of employment to other series representing the volume of activity, such as bank clearings outside New York City. There is conclusive evidence that employment affords a highly satisfactory index of industrial activity,[1] both before and since the war.

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[1] Edmund E. Day, *An Index of the Physical Volume of Production*, pp. 62, 63.

[2] For the cycles of pig iron production see Warren M. Persons, "Indices of Business Conditions," *Rev. of Econ. Statis.*, prel. vol. I, pp. 104, 190–4, Jan. and Apr., 1919.

There are important differences in the *amplitudes* of indexes derived from the two sources, chiefly because of cyclical fluctuations in labor efficiency and in the volume of part-time and over-time employment.[2] But when inequalities of amplitude are eliminated by use of the standard deviation as a vertical unit, the *cycles* of activity appear practically the same, whether represented by employment or by production data.[2]

In conclusion attention should be called to other uses of the pre-war and the current indexes of employment. Properly analyzed, they have other economic uses than merely to afford a guide to cycles of productive activity. Employment cycles represent the course of the labor market. The employment manager can estimate the opportuneness of his labor policy by watching the course of employment, just as the financier can time his operations by following the fluctuations in the volume of loanable funds. When workers are already heavily employed we have a "tight" labor market; when employment is less full the labor market is "easy." In each case it is necessary, though not sufficient, to watch the course of prices or rates, i. e., wage-rates and money-rates; the available *volume* of labor and of capital should also be studied. On the commercial side also the employment cycle has economic significance. The writer has found that wage-rates normally lag nearly a year after employment in this country. That means that buying-power, a composite product of the volume of employment and wage-rates, also lags somewhat after employment. Employment forms a satisfactory first approximation to a barometer, or more strictly a forecaster, of pecuniary buying-power. The employment cycle is therefore of direct concern to the business man, whether he be interested chiefly in the labor market, in production, or in sales.

Not only the business man but also the social worker may find the study of the employment cycle of great practical value. Even though from some points of view it might be desirable to know the number of the unemployed, one may obtain much light as to the seriousness of the social situation at a given time by learning from an index the *relative intensity* of unemployment as compared with that at various times in the past. As contrasted with the usual method of estimating the volume of unemployment, the index has the two-fold advantage that it is probably more reliable, and that it establishes a norm in past experience for judging and interpreting the current employment situation. Some unpublished studies by the present writer seem to demonstrate a clear causal relationship between the business cycle and some eight or ten indexes reflecting social welfare. Undoubtedly a key element in the linkage by which the forces of the business cycle impinge upon general well-being is employment.

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[1] Described in the *Rev. of Econ. Statis.*, prel. vol. 4, pp. 35–39, Jan., 1922. This and other significant relationships of the employment index will be presented more fully in a forthcoming monograph of the Pollak Foundation.

[2] For further treatment of these points see *Rev. of Econ. Statis.*, prel. vol. 4, pp. 17–19, Jan., 1922.

GENERAL INDEXES OF EMPLOYMENT IN THE UNITED STATES

(Unit: one-tenth of one standard deviation)

| | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (A) Pre-war Index | | | | | | | | | | | | |
| 1903...... | 0 | +2 | +3 | +3 | +4 | +6 | +4 | +2 | +3 | 0 | +5 | −5 |
| 1904...... | −8 | −6 | −6 | −6 | −9 | −9 | −7 | −6 | −3 | −1 | −3 | −4 |
| 1905...... | −3 | −1 | 0 | +4 | +5 | +3 | +3 | +4 | +4 | +6 | +6 | +9 |
| 1906...... | +10 | +8 | +9 | +10 | +11 | +12 | +11 | +9 | +8 | +10 | +10 | +11 |
| 1907...... | +8 | +7 | +11 | +11 | +12 | +13 | +11 | +9 | +6 | +1 | −8 | −16 |
| 1908...... | −20 | −22 | −26 | −23 | −22 | −23 | −20 | −17 | −16 | −11 | −10 | −10 |
| 1909...... | −9 | −9 | −6 | −6 | −4 | −4 | −3 | 0 | 0 | +2 | +3 | +5 |
| 1910...... | +6 | +8 | +6 | +5 | +5 | +4 | +2 | +2 | +3 | 0 | +4 | +1 |
| 1911...... | +1 | 0 | −2 | −2 | −4 | −3 | −3 | −1 | −2 | −1 | −2 | −4 |
| 1912...... | −1 | +1 | 0 | +2 | +3 | +2 | +1 | +6 | +5 | +6 | +6 | +6 |
| 1913...... | +8 | +8 | +3 | +2 | +1 | 0 | 0 | +1 | +2 | −2 | −2 | −4 |
| 1914...... | −4 | −4 | −5 | −4 | −5 | −6 | .... | .... | .... | .... | .... | .... |
| (B) Current Index | | | | | | | | | | | | |
| 1914...... | .... | .... | .... | .... | .... | .... | −11 | −14 | −11 | −11 | −15 | −17 |
| 1915...... | −16 | −16 | −16 | −15 | −13 | −11 | −11 | −10 | −7 | −5 | −4 | −3 |
| 1916...... | −3 | −2 | −1 | +1 | 0 | +2 | +2 | +4 | +5 | +6 | +7 | +6 |
| 1917...... | +8 | +7 | +7 | +5 | +6 | +6 | +7 | +6 | +5 | +7 | +7 | +8 |
| 1918...... | +7 | +6 | +7 | +6 | +6 | +7 | +10 | +9 | +8 | +4 | +5 | +4 |
| 1919...... | 0 | −4 | −5 | −4 | −4 | −1 | +2 | +4 | +3 | +1 | +2 | +5 |
| 1920...... | +7 | +6 | +7 | +8 | +7 | +7 | +4 | +5 | +1 | −1 | −9 | −16 |
| 1921...... | −22 | −20 | −20 | −20 | −20 | −19 | −19 | −18 | −18 | −16 | −17 | −17 |
| 1922...... | −18 | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... |

# NOTES

## THE FEDERAL RESERVE BOARD'S PRICE INDEX FOR GREAT BRITAIN

By Katharine Snodgrass

In the Quarterly for September, 1920, an article was published describing the Federal Reserve Board's index of American prices, the first of a series of international indexes which the Board proposed to construct for the study of the relationship of prices in different countries. Since that time the British index number has been added to the series, and in the course of the next six months it is hoped that Japanese, Canadian, and French numbers will be completed.

### CLASSIFICATION OF COMMODITIES

The British number is of approximately the same size as the American, *i. e.*, 60 to 65 different commodities are included, many of them represented by several quotations, so that the total number of different quotations is between 90 and 100 in both cases. For the most part, the same commodities are included in both indexes. The British index, however, contains 10 commodities which are not in the American, while the latter contains 7 which are not in the British.[1] The method of construction and the classification of commodities is the same in both cases. All commodities have first been separated into domestic or home produced materials, and imported goods. Each of these groups has then been subdivided into (1) raw materials, (2) producers' goods, and (3) consumers' goods. In the case of the British index the following ratios show the importance of each of these groups to the total:

RATIO OF GROUP INDEXES TO TOTAL IN BRITISH INDEX

| | Goods produced | Goods imported | Raw materials | Producers' goods | Consumers' goods | All |
|---|---|---|---|---|---|---|
| | Per cent | Per cent | Per cent | Per cent | Per cent | Per cent |
| Average, 1913... | 73 | 27 | 40 | 30 | 30 | 100 |
| June, 1921...... | 77 | 23 | 40 | 27 | 33 | 100 |

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[1] A list of the quotations used in the construction of the British index number with the sources from which the quotations were drawn may be found in the Federal Reserve Bulletin for February, 1922. A similar list for the American index is published on p. 500 of the Federal Reserve Bulletin for May, 1920. Revisions of this list may be found on p. 702 of the Bulletin for June, 1921, and p. 574, for May, 1922.

In the American index the ratios are very different for domestic and imported goods, and raw materials bear a higher ratio to manufactured goods than in the British index.

RATIO OF GROUP INDEXES TO TOTAL IN AMERICAN INDEX

| | Goods produced | Goods imported | Raw materials | Producers' goods | Consumers' goods | All |
|---|---|---|---|---|---|---|
| | Per cent | Per cent | Per cent | Per cent | Per cent | Per cent |
| Average, 1913... | 93 | 7 | 45 | 19 | 36 | 100 |
| June, 1921...... | 96 | 4 | 43 | 19 | 38 | 100 |

One additional group index has been constructed for both countries, namely, that of the prices of goods exported. As in the case of imports, this index is more important for England than for the United States, the British export index bearing a ratio of 20–25 per cent to goods produced, while in the case of the American index the ratio is normally somewhat under 10 per cent. This classification of the goods included in the indexes under domestic, imported, and exported is especially interesting at the present time because of the maladjustment between domestic and foreign prices which has come about as a result of the limitations which have been placed upon the use of gold in foreign exchange. The further classification according to stage of manufacture is useful as supplementary information in the study of prices according to groups of industries. Until this index was constructed there was no British index which contained classifications other than those along industrial lines. The old Board of Trade index gave the foreign trade classification, but its results were vitiated by the fact that customs values instead of market quotations were used.

## METHOD OF CONSTRUCTION

Both the American and the British index numbers are of the weighted, arithmetic type. In other words, each index is based upon the aggregate money value represented by the quantity of the goods produced and imported in 1913 multiplied by their prices. These aggregates are expressed in terms of percentages of the 1913 base which is assumed to be normal.[1] Considerable difficulty was encountered in arriving at satisfactory production weights for the British index because no census has been taken since 1907. In several industries studies had been made during the war, which were useful; but in a few cases it was necessary to be satisfied with rather rough estimates. Export and import quantity weights were carefully adjusted by value figures so that there would be no over- or under-weighting in cases where price quotations of imports or exports were higher or lower than average. This type of adjustment could not be applied to the weighting of the "goods produced," however, because of inadequate data. In a few cases, such as the iron and steel industry, the weights were increased to give representation to commodities more highly manufactured than those in the index. The following table shows the importance of the several industries in the final index number for 1913:

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[1] For more detailed description of the method of construction used in the American index, see p. 326 of the Quar. Pub., of the Amer. Stat. Ass'n for September, 1920. The British index has been identically constructed.

IMPORTANCE OF THE SEVERAL INDUSTRIES IN BRITISH PRICE INDEX IN 1913

| | Per cent |
|---|---|
| Grains | 10 |
| Meats | 9 |
| Other foods | 11 |
| Iron and steel | 15 |
| Coal and coke | 17 |
| Other minerals | 3 |
| Cotton | 14 |
| Wool | 8 |
| Other textiles | 2 |
| Miscellaneous | 11 |
| Total | 100 |

## PRICE QUOTATIONS

Considerable care was used both in the choice of the commodities included in the index and in the sources from which the quotations were taken. In general, it may be said that all of the leading British industries are represented in the index, some more satisfactorily than others, to be sure, but all to a certain degree. Probably the most serious omissions are woolen cloth, imported hides, and domestic leather. No quotations for woolen cloth are published and no manufacturers could be found who were willing to divulge their own quotations. There are also no satisfactory foreign hide or domestic leather prices available, partly because of the lack of any generally recognized standards for materials in the trade. Other lines which gave especial difficulty but for which quotations were finally obtained are raw wool, raw and finished tobacco, paper, and lumber. Reliable foreign wool prices are not published in any British trade paper in a form intelligible to the people who are not following the trade closely. After each auction, however, summaries of the prices which prevailed for the different grades of the commodity at the preceding auction are compiled by various wool brokers. This type of quotation has been used in the index and is probably as satisfactory a price as can be obtained for most commodities, except that the quotations are likely to be somewhat irregular. At the present time, however, auctions are held almost every month. Tobacco and lumber prices had to be obtained from private firms, since no satisfactory price-collecting agency seems to exist in these industries. Prices could not be obtained for paper of any variety, and quotations for sulphate bleached were used to represent the industry.

Very satisfactory price-reporting services are conducted by the *British Board of Agriculture* for live stock and meat prices, by Bromhall's *Corn Trade News* for grains, the *Wool Record* for wool tops and yarns, the *Manchester Guardian* for cotton in all stages of manufacture, the *Iron and Coal Trades Review* for coal, the *Iron and Steel Trades Journal* for these and other metals, the *Chemical Trades Journal* for chemicals. Other periodicals which have been used are *The Grocer*, *Textile Mercury*, *Oil News*, *World's Paper Trade Review*, *Mark Lane Express Agricultural Journal*, *Leather World*, the *Statist*, and the

TABLE I

BRITISH INDEX NUMBER FOR THE POST-WAR PERIOD (1913=100)

| | Goods produced | Goods imported | Goods exported | Raw materials | Producers' goods | Consumers' goods | All commodities |
|---|---|---|---|---|---|---|---|
| 1919 | | | | | | | |
| Jan. | 221 | 244 | 242 | 210 | 238 | 241 | 227 |
| Feb. | 215 | 240 | 231 | 208 | 229 | 234 | 222 |
| March | 202 | 233 | 222 | 206 | 200 | 226 | 210 |
| April | 208 | 230 | 219 | 207 | 213 | 225 | 214 |
| May | 220 | 234 | 232 | 211 | 237 | 229 | 224 |
| June | 231 | 241 | 233 | 216 | 257 | 236 | 234 |
| July | 240 | 247 | 265 | 222 | 269 | 244 | 242 |
| Aug. | 250 | 246 | 278 | 234 | 277 | 243 | 249 |
| Sept. | 253 | 246 | 302 | 239 | 277 | 241 | 251 |
| Oct. | 262 | 259 | 332 | 250 | 288 | 249 | 261 |
| Nov. | 273 | 269 | 345 | 255 | 310 | 260 | 272 |
| Dec. | 283 | 280 | 399 | 261 | 331 | 267 | 287 |
| 1920 | | | | | | | |
| Jan. | 302 | 298 | 452 | 270 | 358 | 289 | 305 |
| Feb. | 316 | 314 | 478 | 281 | 392 | 291 | 320 |
| March | 327 | 319 | 483 | 287 | 406 | 300 | 329 |
| April | 332 | 324 | 486 | 292 | 409 | 306 | 334 |
| May | 341 | 322 | 484 | 306 | 406 | 310 | 340 |
| June | 344 | 306 | 469 | 308 | 396 | 311 | 339 |
| July | 330 | 299 | 452 | 307 | 363 | 302 | 326 |
| Aug. | 322 | 304 | 439 | 307 | 352 | 297 | 322 |
| Sept. | 319 | 288 | 421 | 301 | 341 | 296 | 315 |
| Oct. | 301 | 272 | 392 | 290 | 309 | 282 | 297 |
| Nov. | 285 | 253 | 369 | 282 | 278 | 267 | 280 |
| Dec. | 266 | 230 | 328 | 265 | 244 | 255 | 260 |
| 1921 | | | | | | | |
| Jan. | 252 | 207 | 246 | 233 | 231 | 261 | 244 |
| Feb. | 234 | 190 | 201 | 213 | 213 | 246 | 226 |
| March | 219 | 182 | 189 | 202 | 198 | 231 | 213 |
| April | 211 | 180 | 185 | 201 | 184 | 225 | 206 |
| May | 209 | 167 | 182 | 198 | 179 | 216 | 201 |
| June | 206 | 161 | 179 | 196 | 173 | 213 | 197 |
| July | 204 | 164 | 174 | 192 | 165 | 222 | 196 |
| Aug. | 202 | 165 | 168 | 193 | 161 | 223 | 195 |
| Sept. | 199 | 170 | 171 | 195 | 165 | 212 | 194 |
| Oct. | 192 | 163 | 175 | 187 | 166 | 200 | 187 |
| Nov. | 182 | 154 | 164 | 177 | 153 | 191 | 177 |
| Dec. | 176 | 152 | 158 | 173 | 147 | 186 | 172 |
| 1922 | | | | | | | |
| Jan. | 174 | 149 | 158 | 171 | 147 | 181 | 170 |
| Feb. | 171 | 148 | 151 | 168 | 144 | 181 | 167 |
| March | 172 | 147 | 153 | 170 | 142 | 183 | 168 |
| April | 171 | 148 | 152 | 167 | 143 | 183 | 167 |

*Economist*, the latter two only when no trade journal could be found which quoted prices. In the American price work it had been found that unless a large amount of money could be spent, it was preferable to use reliable trade publications as a source for quotations rather than private firms. The same is true of the British situation. It is only in the case of a few highly manufactured commodities such as shoes that quotations of private firms have been used.

### THE INDEX NUMBERS

Neither the British index nor the American index was constructed for the war period. The indexes cover 1913 (which is used as the base period), 1919, 1920, and 1921 and are being constructed currently each month. The table preceding contains the British index numbers for the post-war period expressed in their ratio to the base period (1913). This number for all commodities agrees very closely with the new index of the British Board of Trade which was first published in the spring of 1921. The latter index has not been constructed for 1919, but during 1920 and 1921 there was a high degree of similarity in the movement of the two index numbers. The correlation of the Federal Reserve Board index with the *Economist* and the *Statist* indexes is not so great, although there is not a wide divergence between them. The Board of Trade index is based upon something over 150 price quotations, is roughly weighted, and is a geometric average; the *Economist* and the *Statist* indexes are only about a third as large as the Board of Trade index, are based mainly upon the prices of raw materials and semi-finished goods, are weighted only by the number of quotations assigned to each commodity, and are averaged arithmetically.

In a period of rapid price change like the one since the war it would be presumptuous to claim infallibility for any price index. For instance, if a weighted geometric instead of a weighted arithmetic average had been used in the construction of the Federal Reserve Board index in the months from January, 1920, to June, 1921, the level of British prices would have worked out 5 to 10 per cent lower than it does on the arithmetic basis. The greatest difference between the arithmetic and the geometric averages occurs when there is a wide deviation from the average in the prices of important commodities. During the period of highest prices in the spring of 1920, the dispersion of quotations for leading commodities was so wide that it is impossible to choose the point of greatest concentration. During this same period there was a relatively high degree of concentration of the prices of the less important commodities, but these combined had little influence in determining the final average. As the price level in England declined, the dispersion of individual prices also diminished, and as a result the geometric and the arithmetic averages came into closer harmony. Although no definite experiments have been made, it cannot be doubted that a change in the period upon which the "weights" are based would make similar differences in the final index number, as would the addition or the elimination of an important commodity from the index.

In the following table the all-commodities indexes of these four agencies are compared:

TABLE II

ALL COMMODITIES WHOLESALE PRICE INDEX NUMBERS FOR ENGLAND

(1913=100)

| | Federal Reserve Board | Board of Trade | Statist | Economist |
|---|---|---|---|---|
| 1919 | | | | |
| Jan. | 227 | ... | 224 | 217 |
| Feb. | 222 | ... | 220 | 215 |
| March | 210 | ... | 217 | 212 |
| April | 214 | ... | 217 | 214 |
| May | 224 | ... | 229 | 222 |
| June | 234 | ... | 235 | 230 |
| July | 242 | ... | 243 | 239 |
| Aug. | 249 | ... | 250 | 241 |
| Sept. | 251 | ... | 252 | 245 |
| Oct. | 261 | ... | 264 | 252 |
| Nov. | 272 | ... | 271 | 259 |
| Dec. | 287 | ... | 276 | 273 |
| 1920 | | | | |
| Jan. | 305 | 303 | 288 | 288 |
| Feb. | 320 | 317 | 306 | 303 |
| March | 329 | 326 | 307 | 310 |
| April | 334 | 332 | 313 | 306 |
| May | 340 | 333 | 305 | 304 |
| June | 339 | 330 | 300 | 291 |
| July | 326 | 324 | 299 | 292 |
| Aug. | 322 | 320 | 298 | 287 |
| Sept. | 315 | 318 | 292 | 284 |
| Oct. | 297 | 309 | 282 | 266 |
| Nov. | 280 | 293 | 263 | 245 |
| Dec. | 260 | 269 | 243 | 220 |
| 1921 | | | | |
| Jan. | 244 | 251 | 232 | 209 |
| Feb. | 226 | 230 | 215 | 192 |
| March | 213 | 215 | 208 | 189 |
| April | 206 | 209 | 199 | 183 |
| May | 201 | 206 | 191 | 182 |
| June | 197 | 202 | 183 | 179 |
| July | 196 | 198 | 186 | 178 |
| Aug. | 195 | 194 | 181 | 179 |
| Sept. | 194 | 191 | 175 | 183 |
| Oct. | 187 | 184 | 163 | 170 |
| Nov. | 177 | 176 | 161 | 165 |
| Dec. | 172 | 171 | 157 | 162 |
| 1922 | | | | |
| Jan. | 170 | 167 | 156 | 159 |
| Feb. | 167 | ... | 155 | 158 |
| March | 168 | 165 | 157 | 160 |
| April | 167 | 163 | 158 | ... |

## VALUE OF THE WORK

In 1919, when work was commenced on this series of international price indexes, there was the greatest dissimilarity among the numbers in current use in the various countries. In the United States the index of the Department of Labor was generally recognized as the best, but it was based upon about 325 price quotations while most of the foreign indexes consisted of no more than 50 or 60. It seemed essential, therefore, as a prerequisite to accurate studies of price trends or price levels in different countries, to have a series of comparable or at least representative index numbers. In the course of the two years since that time a great deal of price work has been done in foreign countries, so that the situation is altered in important respects. In England the Board of Trade has revised and enlarged its index. The same is true of the Bachi index for Italy, while in Germany the *Frankfurter Zeitung* has constructed a new fairly large one. It is now possible, therefore, to make fairly accurate comparisons of wholesale prices in general in these countries, both on a paper and on a gold currency basis. The greatest value in the work of the Federal Reserve Board is that it concentrates within one organization an unusually comprehensive body of comparable international price material and that this material is handled in a similar fashion in the construction of its various index numbers. In addition, new classifications of commodities have been made which bring out interesting facts for the student of international price relationships. It also appears to be fairly well established, in view of the similarity between the Board of Trade and the Federal Reserve Board indexes for England, and between the Department of Labor and the Federal Reserve Board indexes for the United States, that very satisfactory wholesale price indexes can be constructed on the basis of less than 100 quotations.

## MONTHLY PRODUCTION OF PIG IRON, 1884 TO 1903

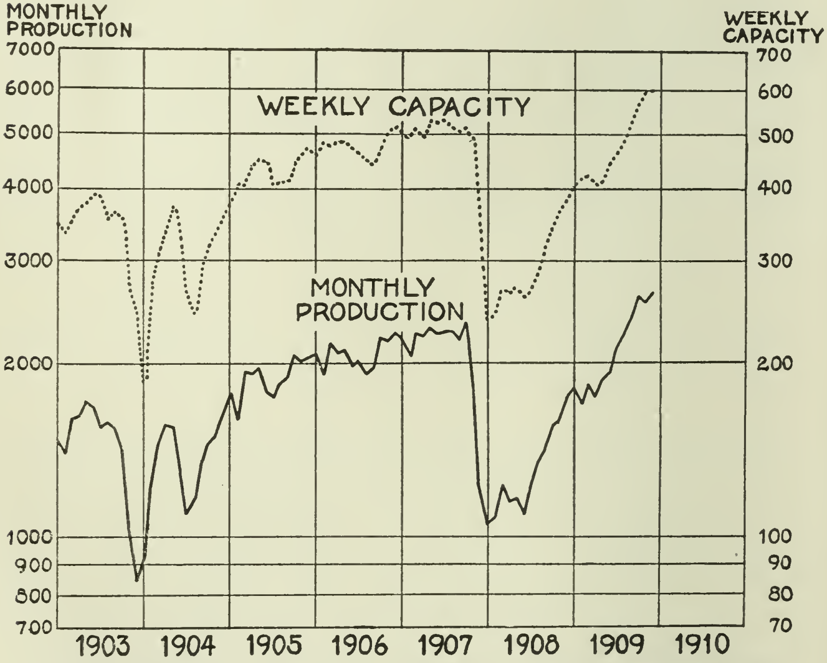
By Margaret G. Myers

Production of pig iron is perhaps the best single index which we have of the volume of industrial activity in the United States. Its fluctuations agree closely with a number of composite indexes of business and industrial activity which have been made up from time to time, and they also tend to move with such records of general business activity as employment, bank clearings, and freight traffic. For this reason the fluctuations are of unusual interest. Annual figures on pig iron production are available practically continuously as far back as 1846. Monthly figures, however, were not collected until 1903, when the *Iron Age* began a compilation for the different kinds of pig iron.

Prior to 1903 there had been published by the *Iron Age* for each month as far back as 1884 figures for the number of furnaces in and out of blast, and the weekly capacity of furnaces in and out of blast at the first of each month. Although the figures for the number of furnaces do not furnish a true indication of the amount of production, the figures for weekly capacity of furnaces in blast run very close to production figures. For the years from 1903 to 1909 reports are available both for weekly capacity of furnaces in blast and for the monthly production of pig iron. The two series are shown in the accompanying diagram.

The close correspondence of the fluctuations of the two lines indicates the possibility of predicting production from the weekly capacity in blast. The coefficient of correlation between the two series is +.975. In computing this coefficient no allowance has been made for secular trend because the particular period under review does not show such a trend in marked degree.

From the figures for the years 1903 to 1909 a regression equation



Reported Weekly Capacity of Furnaces in Blast Compared with Production of Pig Iron Each Month

(Figures in thousands of tons)

was computed to obtain the relation between production and weekly capacity in blast. The resulting formula was $x = 8.1 + 4.34y$, in which $x$ = production and $y$ = weekly capacity in blast, and the figures are in round thousands of tons. By the use of this formula production figures have been computed for each month from 1884 to 1902. The resulting figures are shown in the following table. They were reproduced in graphic form in the *Monthly Review of Credit Conditions*, of the Federal Reserve Bank of New York, for March 1, 1922, together with the figures for succeeding years which have been published currently in the *Iron Age.*

MONTHLY PRODUCTION OF PIG IRON COMPUTED FROM THE WEEKLY CAPACITY OF FURNACES IN BLAST AT THE FIRST OF EACH MONTH

(In thousands of long tons)

| | 1884 | 1885 | 1886 | 1887 | 1888 | 1889 | 1890 | 1891 | 1892 | 1893 |
|---|---|---|---|---|---|---|---|---|---|---|
| Jan. | 329 | 260 | 373 | 503 | 533 | 624 | 711 | 681 | 776 | 724 |
| Feb. | ... | 282 | 377 | 534 | 459 | 606 | 713 | 594 | 772 | 711 |
| March | ... | 312 | 377 | 542 | 429 | 611 | 737 | 546 | 798 | 737 |
| April | ... | 299 | 433 | 551 | 446 | 607 | 736 | 460 | 768 | 746 |
| May | 342 | 299 | 468 | 559 | 472 | 590 | 742 | 468 | 737 | 759 |
| June | 325 | 290 | 481 | 395 | 476 | 555 | 737 | 603 | 711 | 729 |
| July | 334 | 286 | 477 | 433 | 451 | 577 | 716 | 703 | 698 | 642 |
| Aug. | 312 | 290 | 468 | 442 | 477 | 577 | 676 | 698 | 646 | 446 |
| Sept. | 294 | 282 | 451 | 533 | 507 | 585 | 698 | 698 | 624 | 347 |
| Oct. | 286 | 286 | 472 | 568 | 525 | 611 | 729 | 737 | 655 | 303 |
| Nov. | 294 | 303 | 481 | 572 | 564 | 672 | 724 | 772 | 711 | 334 |
| Dec. | 299 | 342 | 490 | 564 | 601 | 685 | 707 | 781 | 733 | 416 |

| | 1894 | 1895 | 1896 | 1897 | 1898 | 1899 | 1900 | 1901 | 1902 |
|---|---|---|---|---|---|---|---|---|---|
| Jan. | 420 | 720 | 885 | 676 | 967 | 1037 | 1254 | 1063 | 1275 |
| Feb. | 425 | 694 | 841 | 694 | 980 | 1019 | 1267 | 1215 | 1419 |
| March | 468 | 672 | 807 | 724 | 1002 | 980 | 1249 | 1245 | 1380 |
| April | 542 | 676 | 798 | 737 | 998 | 1054 | 1232 | 1262 | 1445 |
| May | 468 | 668 | 811 | 733 | 998 | 1071 | 1254 | 1284 | 1475 |
| June | 264 | 672 | 776 | 724 | 959 | 1089 | 1262 | 1340 | 1471 |
| July | 364 | 733 | 763 | 707 | 924 | 1122 | 1202 | 1327 | 1505 |
| Aug. | 494 | 772 | 663 | 707 | 876 | 1141 | 1032 | 1297 | 1436 |
| Sept. | 637 | 833 | 542 | 794 | 906 | 1145 | 980 | 1280 | 1432 |
| Oct. | 642 | 863 | 468 | 854 | 920 | 1189 | 941 | 1314 | 1475 |
| Nov. | 694 | 928 | 525 | 915 | 976 | 1228 | 906 | 1371 | 1440 |
| Dec. | 720 | 928 | 603 | 967 | 1006 | 1262 | 972 | 1384 | 1471 |

The yearly totals of the monthly production figures computed by this means are not far different from annual production figures published by the *Iron Age*, and there is no noticeable tendency toward a greater or less difference as computations are carried back into earlier years.

# THE RATIO OF MALE TO FEMALE BIRTHS AS AFFECTED BY WARS

BY E. R. SHAW

The theory has been advanced that the proportion of male to female births rises during or just after a period of war or similar catastrophe in which the mortality of the males has been unusually heavy, as though nature strove to keep the proportion of the sexes roughly at a constant figure. Düsing, in supporting his contention that late fertilization of females and increased time intervals between fertilizations tend to result in a relatively large number of males, says: "In fact, we note that after every war there is a relative over-abundance of male births. After the Napoleonic Wars this phenomenon was so strongly apparent that people feared a relative shortage of females. This has long been well known, has been noted after every war, and has never been doubted."[1] F. Prinzing refers to this theory also in the *Medizinische Statistik* (1906), where he writes: "After wars the relative number of males is said to be higher. Düsing calls it a well-known fact, and Von Fircks draws this conclusion from the German figures after 1866 and 1871."[2]

This same contention has been brought forward by later statisticians and scientists. In a recent presidential address before the Royal Statistical Society, Sir Bernard Mallet presented figures showing that the proportion of male births to female births in England and Wales, Scotland, and Ireland for the years 1915 and 1916 was above the proportion for the twenty years 1894 to 1913. He stated that for the whole period covered by these war births the proportion of male to female births in England and Wales was 1,046, or eight above the average for the previous forty years, and concluded that "a rise in the sex proportion so marked and sustained over so long a period can hardly be dismissed as an accidental coincidence."[3]

The British *Medical Journal* seems to put some faith in the theory, for it states (Nov. 21, 1914, p. 886) that it is remarkable that in 1857, the year after the return of our army from the Crimea, the excess of male over female births was much higher than the average for the three previous and the three subsequent years, and again immediately after the Boer War in 1901–02 it rose above the average for the preceding period, 1897–1900. So general is the interest in this matter that one of our leading newspapers[1] mentions it and refers to the fact that a scientist of New York City maintains that the hard conditions imposed on women during war times seem to result in a preponderance of male births during and after wars. It also quotes Dr. Corrado Gini as saying that sex determination in a crude form has been exhibited in Italy since the war by a large increase in the number of male children.

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[1] C. Düsing, *Regulierung des Geschlectsverhältnesses*, 1884, p. 19.

[2] *Ibid.*, p. 82.

[3] *Royal Statistical Society Journal*, Jan., 1918, pp. 14–15.

A theory thus upheld by statisticians and scientists, and one which seems to have become traditional, offers a problem of considerable interest. The contention of this paper is that there is no conclusive evidence for the theory of an increased proportion of male over female births during or after wars.

The figures of male and female births after the Franco-Prussian War have been brought forth as upholding this theory. Table I[2] gives the ratios for living births in France.

TABLE I

| Year | Ratio [a] | Year | Ratio | Year | Ratio |
|---|---|---|---|---|---|
| 1862 | 1,052 | 1867 | 1,042 | 1872 | 1,047 |
| 1863 | 1,049 | 1868 | 1,047 | 1873 | 1,050 |
| 1864 | 1,054 | 1869 | 1,050 | 1874 | 1,052 |
| 1865 | 1,051 | 1870 | 1,048 | 1875 | 1,051 |
| 1866 | 1,053 | 1871 | 1,048 | 1876 | 1,047 |

[a] In this and the following tables the ratios are the number of male births per 1,000 female births.

The average proportion for the pre-war years from 1862 to 1869 inclusive was 1,050, for the war years 1870 to 1872 it was 1,048, and for the post-war years 1873 to 1876, 1,050. Though the period after the war shows a greater proportion of male births than the war years, it is no greater than that of the years of peace before 1870.

An investigation of the figures for the German Empire from 1872 to 1880 gives the results shown in Table II.[3]

TABLE II

| Year | Ratio | Year | Ratio | Year | Ratio |
|---|---|---|---|---|---|
| 1872 | 1,053 | 1876 | 1,055 | 1880 | 1,054 |
| 1873 | 1,052 | 1877 | 1,051 | 1872–74 | 1,053 |
| 1874 | 1,054 | 1878 | 1,051 | 1875–80 | 1,054 |
| 1875 | 1,059 | 1879 | 1,053 | | |

If any such effect as an increase of the proportion of male over female births had taken place it would be noticed in the years immediately following the war. For the first three years, 1872 to 1874, the ratio was 1,053. For the years 1875 to 1880 the average ratio was 1,054.

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[1] *New York Times*, Jan. 22, 1922.

[2] *Annuaire Statistique de la France.* Vol. 1, p. 48.

[3] *Statistik des Deutches Reichs.* N. F. Vol. 44, p. 176 (living births only).

The Prussian figures from 1861 to 1880 are given in Table III.[1]

TABLE III

| Year | Ratio | Year | Ratio | Year | Ratio |
|---|---|---|---|---|---|
| 1861 | 1,049 | 1868 | 1,055 | 1875 | 1,060 |
| 1862 | 1,052 | 1869 | 1,055 | 1876 | 1,053 |
| 1863 | 1,047 | 1870 | 1,049 | 1877 | 1,054 |
| 1864 | 1,047 | 1871 | 1,052 | 1878 | 1,051 |
| 1865 | 1,052 | 1872 | 1,053 | 1879 | 1,052 |
| 1866 | 1,048 | 1873 | 1,052 | 1880 | 1,055 |
| 1867 | 1,049 | 1874 | 1,056 | | |

These ratios do not show any consistent rise in the sex proportion of births just after the wars. In 1868–69 the ratio was six above the ratio for 1867; but in 1862 the ratio had increased above that for 1861, and in 1865 it was five above that for 1864. The years immediately succeeding the Austro-Prussian War of 1866 do not show increases greater than those in the preceding years of peace. With regard to the Franco-Prussian War, no increase in the proportion is noticed until 1874 and 1875, in which years the ratio rose to 1,056 and 1,060 respectively, falling again in 1878 to 1,051, and rising to 1,055 in the two years following. The changes in the proportion of male to female births do not come during or just after the war periods with any regularity, and it is hardly justifiable to cite these figures as upholding the theory under discussion. In a paper[2] delivered before the Royal Statistical Society Mr. Nixon presents monthly figures for Prussia which fail to record any effect of the war. The largest rise was from 1,043 in July, 1870, to 1,069 in the following month; but this ratio was exceeded both before and after the war. Thus, the proportions of male to female births in Prussia and Germany, just as in France, seem to have been unaffected by the Austro-Prussian and the Franco-Prussian wars.

The Japanese-Chinese War of 1894–95, lasting until about September, 1895, was hardly serious enough to have any effect upon the proportion of male to female births, even if we assume that wars in general do increase it. The proportion of male to 1,000 female births for these years in Japan is given in Table IV.[3]

TABLE IV

| Year | Ratio | Year | Ratio | Year | Ratio |
|---|---|---|---|---|---|
| 1893 | 1,040 | 1895 | 1,050 | 1897 | 1,054 |
| 1894 | 1,052 | 1896 | 1,033 | 1898 | 1,035 |

[1] *Statistique Internationale du Mouvement de la Population.* Vol. 1, p. 329 (living births only).

[2] *Royal Statistical Society Journal*, July, 1916, p. 435.

[3] *Résumé Statistique de L'Empire du Japon.* 1893–98.

It is seen that the ratio is higher in 1894 and 1895, falling in 1896, and rising in 1897. The increase after the war is irregular and offers no support to the theory advanced.

The Boer War of 1899–1902 did not affect the normal sex ratio of births. The proportion of male to female births in England and Wales remained practically stationary—between 1,032 and 1,038—from 1896 to 1900.[1] In 1901 it rose to 1,039, falling in 1902 to 1,027; and for the next five years it again fluctuated as before the war, between 1,032 and 1,037. The sex proportion of births for this period in Scotland is irregular, and no conclusions can be drawn from these figures.

The World War, because of its magnitude and duration, should, if any war does, have influenced the proportion of male to female births. Table V[2] gives the proportion of male to female births for certain of the warring countries as well as for some of the neutral ones.

TABLE V

| Country | 1919 | 1918 | 1917 | 1916 | 1915 | 1914 | 1913 | 1912 | 1911 | 1910 |
|---|---|---|---|---|---|---|---|---|---|---|
| England and Wales[a] | 1,060 | 1,048 | 1,044 | 1,049 | 1,040 | 1,035 | 1,038 | 1,040 | 1,039 | 1,040 |
| Ireland | 1,071 | 1,047 | 1,052 | 1,065 | 1,064 | 1,052 | .... | 1,048 | 1,064 | 1,045 |
| Scotland | 1,064 | 1,045 | 1,054 | 1,056 | 1,047 | 1,033 | 1,041 | 1,051 | 1,045 | 1,037 |
| Netherlands[b] | 1,067 | 1,061 | 1,055 | 1,055 | 1,059 | 1,056 | 1,047 | 1,054 | 1,050 | 1,060 |
| Germany[c] | .... | .... | .... | .... | .... | 1,056 | 1,054 | 1,059 | 1,055 | 1,053 |
| Italy[d] | .... | .... | .... | 1,054 | 1,050 | 1,051 | 1,050 | 1,056 | 1,054 | 1,052 |
| Denmark[e] | 1,064 | 1,057 | 1,046 | 1,055 | 1,052 | 1,048 | 1,056 | 1,055 | 1,046 | 1,053 |
| Switzerland[f] | 1,044 | 1,055 | 1,043 | 1,057 | 1,043 | 1,061 | 1,051 | 1,055 | 1,040 | 1,051 |
| Norway[g] | .... | .... | 1,054 | 1,054 | 1,043 | 1,070 | 1,056 | 1,059 | 1,059 | 1,047 |

[a] *Annual Report of the Registrar-General*, England and Wales. 1919.
*Annual Report of the Registrar-General*, Ireland, for each year.
*Annual Report of the Registrar-General*, Scotland. 1919.
[b] *Annuaire Statistique*, Netherlands. 1919.
[c] *Annuaire Internationale de Statistique*. 1917.
[d] *Annuaire Statistique*, Italy. 1917–18.
[e] *Annuaire Statistique*, Denmark. 1920.
*Reports of Births, Deaths, and Marriages*, Denmark, 1911–15.
[f] *Annuaire Statistique*, Switzerland. 1920.
[g] *Annuaire Statistique*, Norway. 1920.

In England and Wales the ratio was 1,039 for the four years preceding the war; during the war years it averaged 1,043, and in 1919 rose to 1,060, falling in 1920[3] to 1,052. Although in Ireland the highest ratio came in 1919 it fell in 1920, during which year it was less than it had been in two of the war years. The same general trend holds true for Scotland. The figures for Germany show a rise in 1916–17, but no change in the years immediately preceding. As far as the Italian figures go, no change in the proportion of sexes at birth is noticed during the war years. The Netherlands have an average of 1,053 for the four years preceding the war, and for the war years an average of 1,055. The proportion does not remain a constant figure, but drops in the years 1916–17 to rise again in 1918.

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[1] See the reports of the Commissioner of England, Scotland, and Wales. Vol. 14, 1914.

[2] For living births only. Where no figures are given, reports are not available.

[3] For 1920 figures see the *Statesman's Year Book*, 1921.

Denmark, which was a neutral country, had an average proportion in the years 1911–13 of 1,049, in the war years of 1,051, and in 1919 of 1,064. Switzerland averaged 1,049 from 1910 to 1913, and 1,052 for the war years. For the other countries the data are incomplete, and what there are can furnish no information of value here. In the European countries which have just been reviewed the proportion of male births to female births is so irregular that no positive deductions can be made. Although in England, for instance, the proportion rises during the latter years of the war, it should be noted that this is likewise true for Switzerland and Denmark, which were neutral countries and, as far as loss of male life was concerned, were unaffected. What evidence these figures offer is quite inconclusive in supporting the theory.

Owing to the lack of registration statistics in the United States only the numbers of births by sex since 1915 are available, and these only for the registration area, which constitutes a comparatively small part of the United States. In no state has there been any increase in the ratio of male births over female births decided enough to warrant any conclusions. Thus, in 1919 in Connecticut the proportion rose from 1,041 to 1,068, but in the neighboring state of Massachusetts in the same year it fell from 1,061 to 1,036. Computations for the whole registration area only are given in Table VI.[1]

TABLE VI

| Year | Ratio | Year | Ratio | Year | Ratio |
|---|---|---|---|---|---|
| 1915 | 1,055 | 1917 | 1,058 | 1919 | 1,056 |
| 1916 | 1,057 | 1918 | 1,058 | | |

The proportion for the whole registration area was greater in 1919 than in 1915, but lower than in the three intervening years, and these figures fail to support the theory advanced. Since the registration area has enlarged each year, the proportions for the registration area as it was in 1915 have been computed for several years, as shown in Table VII.

TABLE VII

| Year | Ratio | Year | Ratio | Year | Ratio |
|---|---|---|---|---|---|
| 1915 | 1,055 | 1917 | 1,053 | 1919 | 1,054 |
| 1916 | 1,055 | 1918 | 1,056 | | |

These figures likewise fail to show any rise in the ratio during or after the war.

[1] Birth Statistics in the Registration Area of the United States (1915–19).

The general conclusion of the study is that what Düsing considered to be a well-known and undoubted phenomenon is not established by statistical proof. To offset the disproportionate loss of male life from the disasters of war is a matter of such importance to the race that we can scarcely believe that it is left to chance. But to hold that this is accomplished by a rise in the proportion of male births to female births after a period of war is to go contrary to the evidence. If the ratio of the sexes at birth does not change, can the economic and industrial confusion entailed by a war press more heavily on the female sex and so raise the proportion of female deaths to all deaths?

## SECTIONAL TRENDS IN DEPARTMENT STORE TRADE, 1919–22

By Lawrence B. Mann

How has the business depression affected retail buying in different sections of the United States? The monthly sales of 156 department stores which report regularly to the Federal Reserve banks form a convenient body of data for use in the analysis of this problem. These stores are distributed through seven of the twelve Federal Reserve districts, and fairly represent department store activity in all sections of the United States except the middle west. In Table I the sales of stores in each Federal Reserve district are totaled for each month and converted into index numbers, the average monthly sales for the three years 1919, 1920, and 1921 being used as a base.

The noteworthy features of these figures are the distinct seasonal fluctuations of trade in each district and the remarkable correlation between the seasonal variations in different sections of the country. In each district there is rather restricted business during January and February; a heavy spring buying season which extends through March, April, May, and June; a very slack season during July and August; and heavy fall buying which culminates in a distinct peak at the Christmas season. These seasonal fluctuations are of about the same degree of sharpness in the Boston, New York, Richmond, Atlanta, and Dallas districts, but are considerably less marked in the Minneapolis and San Francisco districts.

In order to eliminate the effect of these acute seasonal fluctuations, new series of index numbers were constructed for each district, the sales for each month being based on the average sales for the corresponding month of the three years, 1919, 1920, and 1921.

## TABLE I

### INDEXES OF DEPARTMENT STORE BUSINESS ON UNIFORM BASES

Monthly average sales 1919–21=100

| Date | District No. 1 Boston 24 stores | District No. 2 New York 60 stores | District No. 5 Richmond 19 stores | District No. 6 Atlanta 9 stores | District No. 9[a] Minneapolis 10 stores | District No. 11[a] Dallas 16 stores | District No. 12 San Francisco 18 stores |
|---|---|---|---|---|---|---|---|
| 1919 | | | | | | | |
| Jan. | 71 | 69 | 70 | 64 | ... | ... | 65 |
| Feb. | 62 | 61 | 64 | 67 | ... | ... | 59 |
| March | 78 | 75 | 90 | 84 | ... | ... | 76 |
| April | 91 | 91 | 103 | 86 | 94 | ... | 82 |
| May | 92 | 89 | 94 | 89 | 107 | ... | 83 |
| June | 89 | 86 | 92 | 79 | 100 | ... | 80 |
| July | 68 | 66 | 72 | 72 | 88 | 68 | 78 |
| Aug. | 70 | 63 | 66 | 68 | 83 | 69 | 89 |
| Sept. | 86 | 86 | 89 | 87 | 108 | 99 | 91 |
| Oct. | 110 | 118 | 108 | 103 | 119 | 112 | 107 |
| Nov. | 108 | 115 | 113 | 110 | 113 | 116 | 97 |
| Dec. | 162 | 166 | 169 | 166 | 145 | 174 | 162 |
| 1920 | | | | | | | |
| Jan. | 97 | 100 | 84 | 90 | 95 | 97 | 98 |
| Feb. | 74 | 78 | 73 | 79 | 78 | 88 | 79 |
| March | 107 | 111 | 110 | 106 | 102 | 122 | 104 |
| April | 110 | 106 | 104 | 112 | 110 | 111 | 103 |
| May | 112 | 117 | 105 | 117 | 112 | 115 | 108 |
| June | 113 | 110 | 111 | 100 | 112 | 110 | 101 |
| July | 80 | 80 | 83 | 82 | 98 | 86 | 93 |
| Aug. | 78 | 71 | 80 | 89 | 91 | 87 | 107 |
| Sept. | 98 | 92 | 95 | 98 | 108 | 111 | 103 |
| Oct. | 112 | 123 | 121 | 128 | 115 | 130 | 114 |
| Nov. | 121 | 129 | 128 | 127 | 116 | 131 | 108 |
| Dec. | 162 | 167 | 177 | 171 | 146 | 169 | 167 |
| 1921 | | | | | | | |
| Jan. | 98 | 96 | 87 | 83 | 89 | 87 | 96 |
| Feb. | 79 | 80 | 79 | 81 | 69 | 83 | 85 |
| March | 110 | 106 | 111 | 101 | 96 | 104 | 104 |
| April | 108 | 105 | 101 | 90 | 105 | 90 | 97 |
| May | 107 | 103 | 101 | 95 | 92 | 97 | 103 |
| June | 110 | 102 | 105 | 84 | 95 | 89 | 96 |
| July | 70 | 71 | 72 | 65 | 76 | 65 | 85 |
| Aug. | 75 | 68 | 71 | 72 | 80 | 65 | 106 |
| Sept. | 88 | 84 | 79 | 77 | 89 | 85 | 97 |
| Oct. | 117 | 126 | 113 | 111 | 99 | 106 | 111 |
| Nov. | 113 | 119 | 110 | 103 | 95 | 97 | 103 |
| Dec. | 171 | 170 | 167 | 148 | 127 | 150 | 164 |
| 1922 | | | | | | | |
| Jan. | 91 | 84 | 71 | 68 | 68 | 70 | 89 |
| Feb. | 78 | 76 | 68 | 69 | 56 | 68 | 75 |

[a] In calculating bases estimates are made for sales of stores in districts No. 9 and No. 11 for the months of 1919 for which we have no reports.

In analyzing these figures it should be remembered that some allowance should be made for normal increase of business during a period of three years. Moreover, as the sales are in terms of dollars, their size is considerably influenced by the level of prices. However, disregarding these two external influences for which it is impossible to make accurate allowance, these indexes show very distinct trends in the period since January, 1919.

In each district there was a distinct upward trend of retail business during the year 1919 and the first few months of 1920. This upward

### TABLE II

### INDEXES OF DEPARTMENT STORE BUSINESS ON MONTHLY BASES

Average sales for corresponding months 1919–21=100

| Date | District No. 1 Boston | District No. 2 New York | District No. 5 Richmond | District No. 6 Atlanta | District No. 9[a] Minneapolis | District No. 11[a] Dallas | District No. 12 San Francisco |
|---|---|---|---|---|---|---|---|
| 1919 | | | | | | | |
| Jan. | 80 | 79 | 88 | 81 | ... | ... | 76 |
| Feb. | 86 | 83 | 89 | 89 | ... | ... | 79 |
| March | 79 | 77 | 86 | 86 | ... | ... | 80 |
| April | 89 | 91 | 100 | 90 | 92 | ... | 87 |
| May | 89 | 86 | 94 | 88 | 103 | ... | 85 |
| June | 85 | 86 | 89 | 89 | 98 | ... | 87 |
| July | 93 | 92 | 95 | 98 | 101 | 93 | 91 |
| Aug. | 95 | 94 | 91 | 90 | 99 | 94 | 88 |
| Sept. | 94 | 98 | 101 | 99 | 106 | 101 | 94 |
| Oct. | 98 | 96 | 94 | 90 | 107 | 96 | 97 |
| Nov. | 95 | 95 | 97 | 97 | 104 | 101 | 95 |
| Dec. | 98 | 99 | 99 | 103 | 104 | 106 | 99 |
| 1920 | | | | | | | |
| Jan. | 109 | 113 | 104 | 114 | 110 | 114 | 113 |
| Feb. | 104 | 107 | 101 | 105 | 110 | 112 | 106 |
| March | 110 | 114 | 106 | 109 | 108 | 120 | 110 |
| April | 106 | 105 | 101 | 116 | 107 | 113 | 110 |
| May | 108 | 114 | 105 | 117 | 108 | 114 | 110 |
| June | 109 | 111 | 108 | 114 | 110 | 115 | 110 |
| July | 110 | 110 | 110 | 112 | 112 | 117 | 109 |
| Aug. | 105 | 106 | 110 | 116 | 107 | 118 | 107 |
| Sept. | 108 | 106 | 109 | 112 | 106 | 113 | 106 |
| Oct. | 99 | 100 | 106 | 112 | 104 | 112 | 103 |
| Nov. | 106 | 107 | 109 | 112 | 107 | 114 | 105 |
| Dec. | 98 | 100 | 104 | 106 | 105 | 103 | 102 |
| 1921 | | | | | | | |
| Jan. | 111 | 108 | 108 | 105 | 103 | 102 | 111 |
| Feb. | 110 | 109 | 109 | 107 | 97 | 107 | 114 |
| March | 111 | 109 | 107 | 104 | 102 | 102 | 110 |
| April | 105 | 104 | 99 | 93 | 102 | 92 | 103 |
| May | 103 | 100 | 101 | 95 | 89 | 96 | 105 |
| June | 106 | 103 | 102 | 96 | 93 | 93 | 104 |
| July | 97 | 98 | 96 | 89 | 87 | 89 | 100 |
| Aug. | 100 | 100 | 99 | 94 | 94 | 88 | 105 |
| Sept. | 97 | 96 | 90 | 88 | 88 | 86 | 100 |
| Oct. | 103 | 103 | 99 | 97 | 90 | 92 | 100 |
| Nov. | 99 | 98 | 94 | 91 | 88 | 85 | 100 |
| Dec. | 104 | 101 | 98 | 91 | 91 | 91 | 99 |
| 1922 | | | | | | | |
| Jan. | 102 | 95 | 89 | 85 | 78 | 82 | 103 |
| Feb. | 109 | 104 | 94 | 91 | 79 | 87 | 101 |

[a] In calculating bases estimates are made for sales of stores in districts No. 9 and No. 11 for the months of 1919 for which we have no reports.

movement reached a peak in five of the Federal Reserve districts during the spring or summer of 1920, whereas it did not culminate until the early months of 1921 in New England and on the Pacific Coast. It is noteworthy that the increased buying due to sales and price reductions in New England more than compensated for the loss of trade due to the closing of woolen mills in the summer of 1920, and that sales were only seriously curtailed some months after the depression had spread to the rubber, cotton, shoe, and paper industries. The decline in trade during the fall and winter of 1920 in the Dallas, Atlanta, and Richmond districts was doubtless due primarily to the shrinkage of cotton values, while the drop in grain prices brought about a similar contraction of retail business in the Minneapolis district. Commencing with June, 1920, the value of sales in the New York district also showed some curtailment, but the decline in both the New York and the Boston districts has been much less pronounced than in the southern and the western districts.

It is impossible to predict whether department stores' sales have reached their lowest point for the current business cycle, but the early months of 1922 have shown an encouraging recovery of trade in the eastern sections, while buying on the Pacific Coast has continued to be well maintained. Department store business in the Richmond, Atlanta, and Dallas districts, on the other hand, is still considerably restricted; while sales in the Minneapolis district have been drastically curtailed during 1922.

## WAGE STUDIES OF THE NATIONAL INDUSTRIAL CONFERENCE BOARD: A REPLY

The National Industrial Conference Board has published four reports on changes in wages in the United States.[1] The first two of these reports are examined by Paul H. Douglas, of the University of Chicago, in the September, 1921, issue of this JOURNAL.

The National Industrial Conference Board welcomes fair and constructive criticisms of its reports, since it appreciates that only in this way can the high standard be approached which the Board has set as the goal of its research work. In Mr. Douglas's article, however, there is so much misuse and misinterpretation not only of the data presented by the Board, but also of the data with which the Board's work is compared, as to place the Board's reports in a false light and to warrant a statement in reply.

The two wage studies of the National Industrial Conference Board which Mr. Douglas reviewed were designed as a "survey of changes in wages as measured by earnings" (Research Report No. 31, p. iii) in a number of important manufacturing industries in the United States. There was, therefore, no attempt to discuss the adequacy or inadequacy of wages in relation to the cost of living, because those who were responsible for the reports did not consider that the data available warranted such comparisons.[2] In his review, however, Mr. Douglas ignored the cautions contained in the reports as to what could and what could not be done with the figures, and concentrated his attention upon them primarily to determine the relation of wages to the cost of living.

### I

As Mr. Douglas pointed out, three sources of data regarding changes in the cost of living in the United States or any considerable section thereof are available: (1) studies by the National Industrial Conference Board; (2) studies by the Massachusetts Commission on the Necessaries of Life; (3) studies by the United States Bureau of Labor Statistics. He placed most confidence in the estimates of changes in the cost of living as made by the United States Bureau of Labor Statistics. His reason for this is given as follows:

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[1] National Industrial Conference Board. Research Reports Nos. 20, 31, 35, 45.

[2] In the Board's later studies of changes in wages, the data were such as to make possible a comparison of earnings with the cost of living so as to show "real" wages, and these comparisons were accordingly made.

> It will be seen that the figures of the Massachusetts Commission and the National Industrial Conference Board are from six to eighteen points below those of the Bureau of Labor Statistics. In all probability, however, the data of the Bureau of Labor Statistics are more reliable for the larger cities than are those of the other two. The situation in Massachusetts was undoubtedly not typical of the country as a whole, for that state had an oversupply of houses at the outbreak of the war and rents in consequence rose much more slowly there than in other parts of the country. And it is doubtful whether the investigations of the National Industrial Conference Board were made as carefully or as accurately as those of the Bureau.

A careful examination of this statement justifies the following comment:

(1) National Industrial Conference Board. The statement, "It is doubtful whether the investigations of the National Industrial Conference Board [of the cost of living] were made as carefully or as accurately as those of the Bureau," involves a presumption that the two have been painstakingly compared and that there is a justifiable basis for the assertion. There is, however, no evidence that Mr. Douglas ever tried to inform himself as to the methods used by the Board in collecting and analyzing the data which are used in making its estimates of changes in the cost of living—that he ever examined the schedules or the tabulation sheets, or in any other way attempted to ascertain the degree of care and accuracy used by the Board in making its estimates of changes in the cost of living in the United States.

(2) Massachusetts Commission on the Necessaries of Life. The smallness of the increase in the cost of living in Massachusetts, as compared with the increase shown by the United States Bureau of Labor Statistics for the country as a whole, Mr. Douglas explained by saying that rents had not increased so much in Massachusetts as in other parts of the country. As a matter of fact, on every date for which comparable figures were available, the increases in rents in Massachusetts, as reported by the Massachusetts Commission on the Necessaries of Life, were greater than the increases indicated by the figures of the United States Bureau of Labor Statistics on these same dates for the country as a whole, as is shown in the following table. The smallness of the rent increase does not, therefore, explain why the rise in the cost of living as computed by the Massachusetts Commission on the Necessaries of Life was smaller than that reported by the United States Bureau of Labor Statistics. A comparison of the two sets of figures indicates only the character of the research which produced this statement.

(3) United States Bureau of Labor Statistics. The figures just quoted, showing changes in rents in the United States, were collected in 32 cities from which the Bureau of Labor Statistics obtains costs for all of the items constituting the total cost of living. These data from 32 cities are combined by the Bureau to indicate the average change in the cost of living for the country as a whole, and have been available in this form since October, 1920.[1] *The figures Mr. Douglas*

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[1] *Monthly Labor Review*, Oct., 1920, p. 65; general estimates were published by the Bureau in the October and November, 1919, numbers of the *Labor Review*.

RENT INCREASES IN MASSACHUSETTS AS REPORTED BY THE MASSACHUSETTS COMMISSION ON THE NECESSARIES OF LIFE, AND IN THE UNITED STATES AS REPORTED BY THE UNITED STATES BUREAU OF LABOR STATISTICS, 1913 TO SEPTEMBER, 1921, INCLUSIVE [a]

| Average in 1913 to— | Massachusetts M. C. on N. of L. | United States U. S. B. of L. S. |
|---|---|---|
| | Per cent | Per cent |
| December, 1914 | 3.5 | No change |
| December, 1915 | 4.1 | 1.5 |
| December, 1916 | 5.3 | 2.3 |
| December, 1917 | 3.1 | 0.1 |
| December, 1918 | 16.4 | 9.2 |
| June, 1919 | 15.5 | 14.2 |
| December, 1919 | 29.6 | 25.3 |
| June, 1920 | 39.4 | 34.9 |
| December, 1920 | 51.7 | 51.1 |
| May, 1921 | 59.4 | 59.0 |
| September, 1921 | 61.0 | 60.0 |

[a] Report of the Special Commission on the Necessaries of Life, Jan., 1922, p. 107; *Monthly Labor Review*, Nov., 1921, p. 83.

*used to represent changes in the cost of living in the entire United States were averages of only 18 cities—shipbuilding centers where, as the Bureau of Labor Statistics itself has said, "industry was most stimulated and population most congested, with a consequent tendency to price raising." In June, 1919, it was estimated that the increase in the cost of living in the 18 shipbuilding centers was 10 points higher than in other cities and towns, and 5 points higher than for the country as a whole.*[1]

Mr. Douglas says these figures for the shipbuilding centers "are more reliable for the larger cities" than are those of the Massachusetts Commission on the Necessaries of Life or the National Industrial Conference Board. The use to which he put them was, however, to show the relation between the cost of living and wages in specified industries. None of these industries is concentrated in the large cities but, on the contrary, the industries are located in towns of various sizes in all sections of the country.

## II

When the increase in the cost of living in the 18 shipbuilding cities, where prices were recognized to have increased more than in the country as a whole, was related to the increase in wages as shown in reports of the National Industrial Conference Board, it was still found that real wages were higher than they were before the war. This conclusion was so at variance with Mr. Douglas's own theories[2] regarding the relative economic status of American workmen in 1920 and before the war that it had to be explained. To do this he attempted to show that the rise in wages between 1914 and 1920 reported by the Board was more apparent than real. For this purpose he compared the Board's figures for hourly earnings and for full-time weekly earnings with similar figures of the United States Bureau of Labor Statistics for the boot and shoe industry, woolen and worsted manufacturing, and cotton manufacturing.

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[1] *Monthly Labor Review*, Oct., 1919, p. 1.

[2] See, for example, *Amer. Economic Rev.*, Sept., 1921, p. 409 *et seq.*

This comparison brought out the fact that for most occupations in each industry both hourly earnings and full-time weekly earnings as reported by the Board were lower in 1914 and higher in 1918 than those reported by the Bureau, which, of course, indicated a greater increase between the two dates as reported by the Board than as reported by the Bureau. Mr. Douglas has five explanations for these differences, designed to justify the Bureau's figures and to discredit those of the Board.

The first of these is that the Bureau's figures are averages for the years 1914 and 1918 while those of the Board are for September, 1914, and September, 1918. Mr. Douglas thought that "this might partially explain the greater increase shown by the Conference Board." As a matter of fact, it probably very largely explains the difference. A comparison between the year 1914 and September, 1914, and between the year 1918 and September, 1918, is impossible. A twelve-months' average irons out many fluctuations in wages which might appear from month to month. September in normal times is between seasons for many occupations, and piece-workers especially would earn less in that month in 1914 than their average for the year. In a period of rapidly rising wages such as the year 1918, with almost all seasonal fluctuations eliminated, the average for the year might well be less than in September, the ninth month. There is, therefore, no necessary discrepancy between the two sets of figures.

The other four explanations are not so important as reasons for the difference between the Board's wage figures and those of the Bureau of Labor Statistics, although two of them are worth mentioning as evidence of Mr. Douglas's method. In his attempt to show that the Board's figures were not geographically so representative as those of the Bureau, he called attention to the fact, noted in the Board's own reports, that for cotton manufacturing wages data were obtained only from northern mills. *But for the purpose of discrediting the Board's figures he compared these figures for northern mills only with the Bureau's figures for northern and southern mills combined.* It is, of course, common knowledge that conditions in the southern cotton mills are in so many ways different from those in the north that a comparison of wages in the mills of the north only with wages in the mills of both north and south is utterly meaningless.

Another explanation offered by Mr. Douglas for the difference between the Board's figures and those of the Bureau of Labor Statistics was that "the plants investigated by the Conference Board were undoubtedly almost overwhelmingly non-union, while those of the Bureau included union as well as non-union plants. The membership of the Conference Board is predominantly composed of employers operating non-union shops, and it is from their members that practically all of their wage statistics are taken. Now it is undoubtedly true in general that wages in non-union plants in 1914 were lower than those in union plants," and that during the war they rose more rapidly in non-union plants than in union plants. This statement is another evidence of Mr. Douglas's failure to inform himself as to the basis of the Board's investigations. Had he attempted to do so, he would have found that the distribution of the questionnaires used for the Board's wages investigations are not limited to the Board's own membership but that, on the contrary, the questionnaires are sent to establishments in the different industries regardless of their affiliations, regardless of their labor policies, and without a consideration as to whether they are or are not union shops. Moreover, there is no way of determining from the returned questionnaires themselves whether the shop represented is closed or open, union or non-union. The Board is not interested in that matter in its wages investigations, and its questionnaires have no bearing either designedly or otherwise on union or non-union conditions.

From all of which it seems fair to conclude, not, with Mr. Douglas, that the rise in real wages shown by the National Industrial Conference Board has not been established, but rather that "the writer [of the review] believes that from 1914 to 1918 the purchasing power of hourly wage rates decreased appreciably," and that he set out to discredit any evidence which did not confirm this thesis. For this purpose he has misused, misinterpreted, or deliberately ignored pertinent data relating both to the cost of living and to wages. So far as the comparison of the Board's wage figures with the wage figures of the Bureau of Labor Statistics goes, there is no question as to which is right or which is wrong. They relate to different periods of time and the data were collected by different methods. The fact that they agree as well as they do is more remarkable than that there may be differences between them.

## III

By relating actual earnings in the different industries as reported by the National Industrial Conference Board to the amount necessary to support a family of five on "a minimum standard of health and comfort," Mr. Douglas carried one step further his attempt to show the unfavorable economic position of the American wage-earner. Average yearly earnings are not given in the Board's reports, but he assumed that the average earnings of adult males for one week, multiplied by fifty-two, would provide this figure. Having thus secured average yearly earnings of adult males in the twelve different industries represented, it was necessary to find the actual cost of living. No cost of living figure being available for workers in these industries, he further assumed that the cost of living of a family of five in Philadelphia was representative of the cost of living of workers in the industries manufacturing boots and shoes, chemicals, and the other ten industrial classifications, no matter where they were located. A comparison of the average yearly earnings of adult males in twelve different industries, obtained by multiplying earnings for one week by fifty-two, with the cost of living of a family of five in Philadelphia in the fall of 1918, brought Mr. Douglas to the conclusion that from 23 to 81 per cent more wages was needed in ten of the twelve industries to bring the average earnings of adult males up to the minimum cost of living. A similar comparison for March, 1920, indicated to him that in nine industries from 22 to 59 per cent more was needed to bring earnings up to the minimum cost of living.

The principal objections which might be raised to such procedure for determining the adequacy of wages Mr. Douglas himself presented but dismissed uncertainly and unconvincingly. Each one of these objections, however, is valid. The cost of living does vary greatly from place to place, and no measure of costs in one place can, without careful testing, be taken to measure costs in another. Moreover, the average size of American wage-earners' families in which the father's wages are the only source of income is almost certainly less than five, and in families where there are five persons the average number of wage-earners is almost certainly two at least. This matter is so fully discussed in Research Report No. 41, of the National Industrial Conference Board, as not to require presentation at this point. Another analysis of the same problem from a somewhat different point of view is contained in an article by the present writer in the *American Economic Review* for September, 1921.

The problem of the economic responsibilities of adult male American wage-earners is far from settled and, as has already been pointed out, much careful research is needed before an answer to the question can finally be made. In the meanwhile, however, scientific accuracy requires that figures showing the cost of living or changes in the cost of living be used with extreme care, especially in connection with wages.

It should again be emphasized that the wage studies of the National Industrial Conference Board reviewed by Mr. Douglas were designed primarily to show trends in wages. The uses to which he put the figures were in several instances not justified, and some of his comparisons, both with other wage studies and with studies of the cost of living, were unwarranted. To make his points he undertook a number of elaborate calculations, some of which are open to serious question. Numerous minor points on which the present writer disagrees with Mr. Douglas have not been taken up in the present paper, but enough has been said to indicate that Mr. Douglas's interest in the wage studies of the National Industrial Conference Board was apparently more in relation to his own theories than to the intrinsic value of the studies themselves.

MARGARET LOOMIS STECKER

Research Staff,
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## A REJOINDER

I take it that Mrs. Stecker objects to my review fundamentally on the ground that its criticism of the wage studies of the National Industrial Conference Board was based on insufficient evidence and was animated primarily by a desire to discredit their conclusions in favor of certain others of my own. Naturally, what first attracted my attention to these studies was their divergence from those investigations of the Bureau of Labor Statistics with which I had been dealing. The problem so aroused my interest that I tried to find the reasons for these differences. Further research convinced me that the Bureau's figures were more accurate than those of the Board, for the reasons which I tried to indicate in my review and which I shall once more try to summarize below. I shall take up Mrs. Stecker's criticisms in order.

1. I preferred the cost of living figures of the Bureau of Labor to those of the Massachusetts Commission because the Bureau's figures covered a large number of cities distributed over the country as a whole, while the Massachusetts figures referred only to that state. I agree that I was in error in my statement

that rents had risen far more slowly in Massachusetts than in the rest of the country, although interestingly enough the cost of living statistics of the Conference Board itself would lead one to the identical statement that I made.[1] However, I do not believe that Mrs. Stecker herself would seriously argue that the Massachusetts figures should be preferred as a country-wide index to those of the Bureau. Furthermore, I believe that the Bureau's cost of living figures are more reliable than those of the Conference Board for the following reason: The food index for both studies is the same, the Conference Board merely using that of the Bureau; but the difference in the methods pursued by the two bodies in collecting the other price data is the most significant. All of the original data secured by the Conference Board have always been collected by means of questionnaires sent out to dealers and local groups throughout the country. The data of the Bureau of Labor Statistics, on the other hand, are based upon an extensive collection by field agents in the specific localities covered both (a) of family budgets and (b) of the actual prices of commodities from 1914 on to the present by periods. In the light of this fact, I imagine that all statisticians will agree that my statement that "it is doubtful whether the investigations of the National Industrial Conference Board were made as carefully or as accurately as those of the Bureau," was both moderate and thoroughly justified.

I selected the 18 shipbuilding cities because they were the only localities for which a continuous record existed for the period covered by the wage studies themselves, *i. e.*, from 1914 on. The statistics for the 13 additional cities, which Mrs. Stecker mentions, began only in December, 1917. Nevertheless, I am inclined to agree that it would have been better had I used these 13 cities for the period which they cover. This would have lowered the cost of living index by approximately only 3 points in September, 1918, and by 4 points in March, 1920.

2. The relative reliability of the various cost of living indexes, however, is by no means so important as the question of the relative reliability of the wage data of the Conference Board for the period 1914–18[2] as compared with those of the Bureau of Labor Statistics. I was struck with the fact that the wage statistics of the Conference Board were greatly in excess of those shown by the Bureau for three of the same industries during almost identically the same period. After a close analysis of these three industries, it was found that with identical methods of computation the Board's figures showed an increase in hourly earnings of from 17 to 29 points more than those of the Bureau, and that those for full-time weekly earnings ranged from 11 points higher, as in the case of boots and shoes; to 33 points, as in the case of cotton manufacturing. De-

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[1] See Research Report No. 30. National Industrial Conference Board, pp. 7–12. The average increase in rents for the country as a whole, during the period July, 1914–July, 1920, according to the Board, was 58 per cent. Of the 59 cities, however, where rents had increased over 61 per cent, only 1 was in Massachusetts; 2 of the 26 cities with increases ranging from 51 to 60, and 4 of the 29 cities with increases of from 41 to 50 per cent, were in Massachusetts. There were no less than 6 Massachusetts cities, however, in the 44 with increases of less than 40 per cent.

[2] Mrs. Stecker's implication that I compared the Board's figures with those of the Bureau for the period 1918–20 as well, is erroneous, as the reader of the original review will see. Nor did my independent study go beyond 1918.

spite Mrs. Stecker's contentions, such large differences, amounting in the case of cotton manufacturing to a wage difference of approximately 15 per cent, can be explained only in part by the fact that the Bureau's statistics are for the average of the years in question, while those of the Board are for the month of September. As I indicated, probably by far the largest part of the difference is caused by the different methods of sampling, and I invite a close comparison of the methods used by the two bodies. The Bureau's figures were based upon over 35 per cent more employees in the woolen industry than were those of the Conference Board, upon over 420 per cent more in the case of boots and shoes, and upon 550 per cent more in the case of cotton manufacturing. They were, moreover, collected, in the main, from a wider geographical area, and hence are more reliable as a country-wide index. Mrs. Stecker makes much of the fact that questionnaires were sent to union shops. Has she any assurance, however, that these union shops filled out and returned the questionnaires to the Board in the same proportion as those firms which were members of the Board? In view of the known membership and industrial policies of the Conference Board, are not, indeed, all the probabilities of the case exactly the opposite?

The chief source of difference, however, arises I think from the fact that the Board uses the questionnaire method of collecting wage data, while the Bureau, for the three industries which I compared, used field agents. Now questionnaires are much more likely to produce biased results than schedules administered by field agents, because firms with a low wage scale, or whose increases have been less than the average, are naturally reluctant to fill them out, even though their anonymity is preserved; plants with a high wage scale or that have increased wages above the average will, on the other hand, be much more inclined to return the questionnaires. The indicated increase therefore will tend, almost inevitably, to be greater than the real increase. This danger is avoided by the use of field agents, who can more easily secure data from the low-wage firms or those that have made smaller increases than the average.

3. Finally, I take it that no defence is needed for my attempt to make comparisons of what the average yearly earnings in the various industries would have amounted to on the basis of the given weekly rates, with Mr. W. C. Byer's meticulously careful Philadelphia standard budget. Mrs. Stecker admits that I pointed out the possible objections to such a comparison. She merely emphasizes them more strongly. Space is lacking fully to discuss this subject, and I can only refer the interested reader to my original review where he will find the various points, both pro and con, fully stressed.

Fundamentally, my objection to the studies of the National Industrial Conference Board, whether it be their hours and output series, their cost of living series, or their wage series, is that the studies are all based upon the questionnaire method of collection and a dubious method of sampling. The choice of samples is such a delicate matter, and the voluntary questionnaire method is so susceptible to biases and errors, that few would accept it in preference to data derived from actual field investigations. This basic objection Mrs. Stecker completely avoids in her reply.

In closing, may I correct two errors in the original review which Mrs. Stecker does not mention and the corrections of which were in the editor's hands long before her manuscript was received. In Table I, the unweighted average for actual weekly earnings in March, 1920, should be 237 instead of 235 as printed, and the weighted average should be 235 instead of 234. Secondly, the last two column headings in Table II should be transposed.

Paul H. Douglas

## AN ALL-INCLUSIVE EMPLOYMENT INDEX FOR WISCONSIN

The Statistical Department of the Wisconsin Industrial Commission is constructing an all-inclusive employment index, beginning with January, 1922. Since July, 1920, the department has published a monthly employment index covering mining, quarrying, and manufacturing. A quarterly index including the same groups was also instituted which ran back to the first quarter of 1915.[1]

The new index covers all of the important groups of employment. The kinds of employment represented, together with the number of correspondents in each group, are given in an accompanying list. At least one third of the total number of employees in the state are represented in each of the employment groups except agriculture, building, trade, and miscellaneous professional service.

Although there are 498 correspondents in agriculture, they employ only 0.5 per cent of the farm laborers in the state. In building, about 5 per cent of the state pay-roll is represented; in retail trade, about 15 per cent; and in wholesale trade, about 10 per cent. Professional service, which is a rather heterogeneous group includes nurses, barbers, doctors, lawyers, insurance agents, and real estate agents in the employ of another. Only 1 or 2 per cent of the state pay-roll is represented in this group. In some groups, as Express, Telephone and Telegraph, much more than one third of the state pay-roll is necessarily represented, by reason of the fact that such businesses are natural monopolies.

An index number for each group of employment has been constructed, with January, 1922, as 100. An index number for all groups has not yet been prepared because it has not been determined what weights to assign to the various groups. Within the manufacturing group it is possible to estimate rather accurately the percentage of the state pay-roll represented in each industry by using the 1919 United States Census of Manufactures. But the Census of Occupations is a less satisfactory guide in determining what percentage of the state pay-roll in other major employment groups is represented. This is due to the fact that the Census of Occupations follows occupational rather than industrial lines. Moreover, the division between employees and employers is not clearly drawn.

The original data are secured directly from employers through a very simple questionnaire. The Wisconsin Crop Reporting Service is coöperating with the Industrial Commission in sending out the agricultural questionnaires. Although the form varies slightly for the various employment groups, the essential information called for is: (1) the number of employees on the pay-roll including the 15th day of the month; (2) the total amount of such pay-roll.

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[1] See "An Employment Index for Wisconsin," p. 497, this Journal for Dec., 1920.

After reducing all pay-rolls to a weekly basis, average weekly earnings are obtained by dividing the total pay-roll in each group by the total number of employees. The index number for total employees, the total pay-roll, and the average weekly earnings are then constructed.

The new index number is calculated by comparing the reports of identical establishments in the base month (January, 1922, for the new index) with the reports in the given month. In other words, the same original establishments are used each month instead of a fluctuating number. In the case of agriculture, however, a fluctuating number of correspondents submit data. The index number for the period 1915 to July, 1920, was constructed by first computing quarter-to-quarter link relatives and then shifting the base to the first quarter of 1915. The index number for the period July, 1920, to January, 1921, was constructed from the reports of practically the same establishments each month, although in some months the month-to-month link relative method had to be used.

It is believed that the new all-inclusive index number conforms to all of the criteria set forth by Ernest S. Bradford in a recent article appearing in this publication,[1] so far as they apply to employment statistics, with one exception. Mr. Bradford states that "the figures should show partial unemployment (part-

| GROUPS OF EMPLOYMENT | NUMBER OF CORRESPONDENTS |
|---|---|
| I. MANUAL | |
| Agriculture | 468 |
| Logging | 13 |
| Mining | 6 |
| Lead and Zinc | 3 |
| Iron | 3 |
| Stone Crushing and Quarrying | 12 |
| Manufacturing | 485 |
| Stone and Allied Industries | 17 |
| Brick, Tile, and Cement Blocks | 11 |
| Stone Finishing | 6 |
| Metal | 87 |
| Pig Iron and Rolling Mill Products | 4 |
| Structural Iron Works | 4 |
| Foundries and Machine Shops | 41 |
| Railroad Repair Shops | 6 |
| Stoves | 4 |
| Aluminum and Enamel Ware | 3 |
| Machinery | 10 |
| Automobiles | 3 |
| Other Metal Products | 12 |
| Wood | 87 |
| Sawmills and Planing Mills | 31 |
| Box Factories | 9 |
| Panal and Veneer Mills | 5 |
| Sash, Door, and Interior Finish | 21 |
| Furniture | 11 |
| Other Wood Products | 10 |
| Rubber | 5 |
| Leather | 25 |
| Tanning | 3 |
| Boots and Shoes | 5 |
| Other Leather Products | 17 |
| Paper | 23 |
| Paper and Pulp Mills | 8 |
| Paper Boxes | 6 |
| Other Paper Products | 9 |
| Textiles | 28 |
| Hosiery and Other Knit Goods | 8 |
| Clothing | 7 |
| Other Textile Products | 13 |
| Food | 101 |
| Meat Packing | 3 |
| Baking and Confectionery | 16 |
| Milk Products | 7 |
| Canning and Preserving | 32 |
| Flour Mills | 14 |
| Tobacco Manufacturing | 15 |
| Other Food Products | 13 |
| Light and Power | 13 |
| Printing and Publishing | 63 |
| Laundering, Cleaning, and Dyeing | 32 |
| Chemicals (including Soap, Glue, Explosives) | 4 |
| Construction | 124 |
| Building | 89 |
| Highway | 24 |
| Railroad | 5 |
| Marine, Dredging, Sewer Digging | 5 |
| Communication | 27 |
| Steam Railway | 8 |
| Electric Railways | 11 |
| Express, Telephone and Telegraph | 8 |
| Wholesale Trade | 15 |
| Hotels and Restaurants | 71 |
| II. NON-MANUAL | |
| Manufacturing, Mines and Quarries | |
| Construction | |
| Communication | |
| Wholesale Trade | |
| Retail Trade—Sales Force Only | 46 |
| Teachers | 69 |
| Urban | 45 |
| Rural | 24 |
| Miscellaneous—Professional-service | 12 |
| Hotels and Restaurants | |

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[1] "Methods Used in Measuring Unemployment," p. 990, Dec., 1921.

time employment) as well as complete unemployment." The present writer does not believe that it is possible to secure part-time employment data each month from any considerable number of employees by the use of the questionnaire method. He believes that the change in average weekly earnings, while made up of the two elements, rates of pay and amount of time worked, gives some idea of part-time employment. At semi-annual or annual intervals it is possible to send out more elaborate questionnaires, followed up by field agents, to obtain data on part-time employment. The New York Department of Labor in the February number of the *Industrial Bulletin* publishes the result of an investigation into hours of labor, which is the sort of thing the writer has in mind.

The Wisconsin employment data described above are published monthly in the *Wisconsin Labor Market.* Members of the American Statistical Association wishing to be placed on the mailing list should address the Statistical Department, Wisconsin Industrial Commission, Madison, Wisconsin.

A. J. ALTMEYER
Wisconsin Industrial Commission

## THE DIVISION OF VITAL STATISTICS OF THE UNITED STATES BUREAU OF THE CENSUS

In order to make available information concerning the various bureaus of the United States Government which carry on activities concerned with the public health, the National Health Council[1] has issued six reports. Since members of the American Statistical Association are interested in the Division of Vital Statistics of the United States Bureau of the Census, a résumé of the report on this Bureau is not out of place in this JOURNAL.

### HISTORY AND DEVELOPMENT OF THE BUREAU

The first annual mortality report related to the year 1900 and was published in 1906 as part of a report covering the five years, 1900–04. Previous to that time, mortality reports based on enumerators' returns had been published as early as 1850 and again in 1860 and 1870. Decennial reports and registration records were published in 1880, 1890, and 1900 (census years). There was a registration area as early as 1880, which was enlarged in 1890 and again in 1900, so that it included in 1900 the six New England States, Indiana, Michigan, New Jersey, New York, and the District of Columbia.

Since 1900 the following states have been admitted to the death registration area: 1906, California, Colorado, Maryland, South Dakota, and Pennsylvania; 1908, Washington and Wisconsin; 1909, Ohio; 1910, Minnesota, Montana, North

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[1] The National Health Council is composed of the following organizations: American Public Health Association; American Red Cross; American Social Hygiene Association; American Society for the Control of Cancer; Conference of State and Provincial Health Authorities of North America; Council on Health and Public Instruction of the American Medical Association; National Child Health Council (including the American Child Hygiene Association, the National Child Labor Committee, and the Child Health Organization of America) National Committee for Mental Hygiene; National Organization for Public Health Nursing; National Tuberculosis Association; and the U. S. Public Health Service, as Conference Member.

Carolina (municipalities of 1,000 and over), and Utah; 1911, Kentucky and Missouri; 1913, Virginia; 1914, Kansas; 1916, North Carolina (remainder of state) and South Carolina; 1917, Tennessee; 1918, Illinois, Louisiana, and Oregon; 1919, Delaware, Florida, and Mississippi; 1920, Nebraska. There are also 17 registration cities in non-registration states, making a total of 34 states, the District of Columbia, and 17 cities, or over 80 per cent of the total estimated population of the United States. Only 3 states remain with unsatisfactory registration laws—South Dakota, which had been admitted but was later dropped, Nevada, and Arizona. This leaves 11 states with satisfactory laws which will be ready for admission as soon as they can show 90 per cent complete registration.

The first annual report on birth statistics related to the year 1915, though prior to that time reports of births had been made in the decennial census reports. In 1915 a birth registration area was created, including Connecticut, Maine, Massachusetts, Michigan, Minnesota, New Hampshire, New York, Pennsylvania, Rhode Island, Vermont, and the District of Columbia. In 1916 Maryland was added; in 1917, Indiana, Kansas, Kentucky, North Carolina, Ohio, Utah, Virginia, Washington, and Wisconsin were added. None was added in 1918, and in 1919 Rhode Island was dropped because of failure to send in all transcripts of birth certificates for the year. California, Oregon, and South Carolina were added in 1919, and Nebraska in 1920. Rhode Island was readmitted in 1921, and New Jersey also was recently admitted. Thus, 25 states and the District of Columbia, or over 60 per cent of the total population of the United States, are included in the birth registration area.

## ACTIVITIES OF THE BUREAU

In addition to the principal work of compiling birth and death statistics, the Division also makes up life tables, encourages and promotes uniformity in the local registration laws for births and deaths, issues weekly reports of deaths occuring in sixty of the larger cities, makes special studies of various subjects relating to vital statistics, and coöperates in the statistical work of other government departments and with extra government agencies interested in vital statistics.

Statistics of Births and Deaths.—The statistics of the Division are based upon local records. Certificates of birth and death are made by physicians, midwives, and undertakers, for the city or the county records. For several years the Bureau of the Census has been urging upon local governments the adoption of standard forms for these certificates, and its efforts have met with considerable success. It employs agents to make transcripts of certificates for transmission to the Bureau of the Census in Washington. These agents receive, as a rule, compensation at the rate of three cents for each certificate transcribed. Upon their receipt in the Bureau of the Census the transcripts are edited, and the data are tabulated by the punched-card system and assembled in report form. Reports of birth and death statistics are published in separate volumes annually, by calendar years.

Promotion of Local Registration.—In order to extend the registration area the Bureau of the Census directs a considerable part of the effort of the Division of Vital Statistics to promoting adequate registration in localities outside the present area. In fact, one of the great accomplishments of the Division has been the building up of the registration area from practically nothing to its present nearly complete status. This promotion work consists in educating committees, societies, state legislatures, and the public generally, through publications and press notices, as to the importance of complete registration. It also includes a system of testing the completeness of registration of births and deaths in the various states by means of form letters addressed to clergymen, postmasters, rural carriers, and others, calling for information regarding recent births and deaths.

Manual of Causes of Death.—The American edition of the *Manual of the International List of Causes of Death*, which is the standard authority on this subject, is published by the Division. The Division also publishes the *Index of Joint Causes of Death* and the *Physicians' Pocket Reference*, more than 148,000 copies of which were distributed during the fiscal year 1919.

Life Tables.—Life tables which show the rate of mortality and the number of years of expectation of life of various age groups are constructed. In most cases the geographical field covered by these statistics is limited to the states which for a long time have had an adequate registration of deaths. These states are New York, New Jersey, Indiana, Michigan, and the six New England States, and the District of Columbia. The material used in the construction of these tables includes the estimated populations as of July 1, 1910, and the deaths in the calendar years 1909, 1910, and 1911.

The first publication of life tables was issued in 1916, the statistics referring to the year 1910. A more complete publication is now in press, entitled, *United States Life Tables 1890, 1901, 1910, and 1901–1910.*

Weekly Health Index.—The Division receives weekly telegraphic reports of deaths from 60 of the largest cities. The figures are published in multigraphed statements within seventy-two hours after the close of the week to which they relate. They show, in addition to the number of deaths occurring, (a) the number of deaths in corresponding prior periods of time, (b) the estimated populations, (c) the death rate per year, (d) the number of deaths of infants under one year of age, and (e) the estimated infant mortality rate.

Special Studies.—Monographs are issued from time to time on subjects related to vital statistics. Among these monographs may be mentioned, for purposes of illustration, those relating to cancer and other malignant tumors, influenza mortality, and the standard nomenclature of diseases and pathological conditions, and of injuries and poisonings which have recently been published.

## ORGANIZATION

The Division is under the direction of a chief statistician, W. H. Davis, M.D. There is at present, according to Dr. Davis, a personnel of 124, including the staff in Washington, D. C., and those in the field.

The chief statistician is assisted by an expert chief of division who is in immediate charge of the clerical force and of the production of the work. The

Division is a complete unit in itself; it is related to the rest of the Bureau of the Census only in that it obtains from the Division of the Population and from the Geographer facts of population for census and intercensal years for purposes of calculating rates. The Division also has its own mechanical equipment.

The Division has an appropriation of $825,000 for the three years constituting the decennial period, the first year of which ended June 30, 1920. This amount is divided into $250,000 yearly, and $75,000 for printing.

James A. Tobey

National Health Council

## MISCELLANEOUS NOTES

**New Wholesale Price Index.** The Federal Reserve Bank of New York has recently completed the preparation of an index number of the prices of twenty basic commodities with the object of securing a representative index which can be carried forward from week to week from readily available quotations. The index is an aggregate of weighted prices of twenty raw materials at primary markets. The commodities contained in the index were selected because of their representative character in agriculture, industry, and trade. The weights were determined in the first instance by the amounts of the different commodities produced in the United States and imported from the years 1913 to 1920, but these weights were adjusted so that agriculture, mining, and manufacture might be weighted in accordance with their importance. A thorough search of sources was made in order to secure for each commodity a representative quotation which would be available promptly. The following commodities were included and weighted as indicated: wheat, 9; corn, 5; hogs, 7; steers, 7; sugar, 3; hides, 6; wool, 4; silk, 1; cotton, 11; rubber, 2; pig iron, 8; copper, 3; lead, 1; coal, 12; petroleum, 5; lumber, 7; cement, 1; paper, 4; sulphuric acid, 1; tobacco, 3.

**Statistics of Public Accidents.** The Statistical Committee of the Public Safety Section of the National Safety Council is planning a reporting system for public accidents in American cities. It is proposed first to establish a registration area for public accidents. The committee has drafted forms for uniform recording of the following types of public accidents: highway vehicular accidents, highway non-vehicular accidents, buildings and structures accidents, general accidents, and elevator accidents. Two sets of forms are provided: first, a preliminary record of the accident made by the police or safety officer at the time of the accident, and second, a more complete form giving details developed after investigation and abstracted from court records. The detailed form is to be forwarded to the Public Safety Section of the National Safety Council at convenient times during the year, and the results are to be tabulated and published for the information of the safety movement. Dr. L. I. Dublin is chairman of the committee having this work in charge. Information regarding the reporting system may be obtained from Mr. F. M. Rosseland, Chief, Public Safety Section, National Safety Council, 168 N. Michigan Avenue, Chicago, Illinois.

**A New British Trade Barometer.** The London School of Economics and Political Science (University of London) has followed the example of Harvard University in developing a monthly "Barometer" of the condition of trade and finance. After preparatory work throughout the year 1921, the first results were published in the "Reconstruction of Europe" supplement of the *Manchester Guardian*, April 20, and the publication in this form is arranged for six months, at the end of which time it is hoped that the undertaking will be put on a permanent footing. The barometer gives a large number of series, monthly from January 1919, selected as illustrating the tone of the money and securities markets, production, prices, foreign trade, and employment; these are shown both in tabular and graphic form. From the series are selected four which are believed to be specially symptomatic, and it is hoped that sufficient experience will soon be obtained to allow useful descriptions and even forecasts of the general state of trade. Besides the main section which deals with Great Britain, similar accounts are obtained from Germany, Italy, France, and Belgium, and the whole is given in conjunction with the Harvard account of the United States. The work in London is under the direction of Professor A. L. Bowley.

**Report on the Coal Miners.** The Russell Sage Foundation has published recently the conclusions of its investigations of the coal industry in a report entitled, *The Coal Miners' Insecurity.* Most of the investigations, which have been carried on for several years, were under the direction of Dr. Louis Bloch. The analysis of the industry points to the outstanding fact of the workers' economic insecurity, due in large measure to the irregularity of employment and the amount of unemployment, which makes a marked discrepancy between earnings and the rate of pay. Such insecurity is traced directly to the organization of the industry, which is greatly over-expanded. The various conclusions of the report are discussed under the following topics: the consumption of coal, the capacity of the mines, the increase in mines and miners, intermittent employment and its causes, seasonal variations, the earnings of bituminous miners, absenteeism, and the cost of living. The presentation of the statistical material is made particularly attractive by the excellent charts drawn under the supervision of Mr. Ralph G. Hurlin, statistician of the Foundation.

**Changes in the Research Organization of the Federal Reserve Board.** On May 1 the headquarters of the Division of Analysis and Research of the Federal Reserve Board were transferred from New York City to Washington, D. C. Dr. H. Parker Willis has tendered his resignation as director of the Division, to become effective July 1, but he will continue to work with the Division as consulting economist. Dr. W. H. Steiner has been appointed acting chief, and Mr. H. W. Van Pelt, assistant chief. Mr. Van Pelt will supervise the foreign work of the Division. He will be assisted by Mr. Robert B. Warren, formerly associate editor of the *American City Magazine*, Mr. G. B. Sherwell, formerly assistant manager of the Foreign Department of the Battery National Bank of New York, Mr. M. Nadler, and Miss Ruth Peterson, each of whom will devote attention to a special group of countries. The work on domestic business conditions will be under the supervision of Mr. Lawrence B. Mann, who will be assisted by Mr. Woodlief Thomas. Thus, the work of the Division will continue substantially along the same lines as heretofore, principal consideration being given to domestic and foreign business conditions. Careful attention will be given to the perfection of the regular services in each of these two fields, and special studies on topics of interest will be made from time to time as deemed desirable.

**Special Meetings of the Association.** A special meeting of the American Statistical Association, arranged by the Committee on Business Research, was held on April 13 at the Machinery Club in New York City, the subject for discussion being "Research in Advertising Agencies." Addresses were given by C. W. Hoyt, of Hoyt's Service, Inc., on "The Work of an Advertising Agency"; by Stewart Mims, of the J. Walter Thompson Co., on "The Problem of Research to the Agency and its Clients"; by Joseph Richards, of Joseph Richards Co., on "Methods of Agency Research for its Clients"; and by C. A. Hoppock, of H. K. McCann Co., on "The Use and Methods of Research for the Agency." About 100 members and guests were present.

The Committee on Business Research is planning to hold another meeting in New York early in June, and two or three additional meetings during the fall and early winter. The Committee hopes, through these meetings and through its other activities, (a) to aid in more clearly defining the purpose and scope of business research, to the end that its proper place in a business organization may become more apparent and that the most effective relating of research to management may be brought about; (b) to promote discussion of the methods of such research; and (c) to encourage the interchange of ideas and information among persons engaged in business research.

**Convention of Labor Officials.** The ninth Annual Convention of Governmental Officials of the United States and Canada was held at Harrisburgh, Pa., May 22–26. The program included a child welfare session, and sessions for the discussion of the chief labor problems—mediation, conciliation, compensation, minimum wage and hours, etc. Many labor commissioners were present, and there was a large delegation of labor officials representing the federal government.

The Department of Labor and Industry held its annual meeting at the same time, and included, among others, sessions of safety engineers, the Advisory Council on Women and Children, and the Industrial Editors Association.

**English Economics Journal.** *Economica,* the journal of the London School of Economics in which original work by those connected with the School and others finds its vent, is now well established. The fifth number of the journal has just been published. (Annual subscription 7s 6d, to the Secretary, School of Economics, University of London. Issued three times a year.)

**Population of Canada by Provinces.** The following figures for 1921 are preliminary only, and subject to revision upon the completion of the census:

Alberta, 588,702; British Columbia, 524,563; Manitoba, 612,565; New Brunswick, 387,876; Nova Scotia, 523,837; Ontario, 2,929,054; Prince Edward Island, 88,615; Quebec, 2,349,067; Saskatchewan, 762,004; Yukon, 4,162; North West Territories, 6,684; Royal Canadian Navy, 485.

**Meeting of the Committee on the Growth of Children.** A third meeting of the Committee of Representatives of National Organizations interested in the study of growth of children was held at the office of Dr. L. Emmett Holt, New York City, on March 4, to discuss plans for standard tables of heights and weights of children. The members of the committee, which is constituted an advisory committee of the National Child Health Council, are: Drs. L. Emmett Holt, Chairman; Bird T. Baldwin, Taliaferro Clark, Louis I. Dublin, W. R. P. Emerson, S. McC. Hamill, Frank Manny, W. T. Porter, Anna E. Rude, Edgar Sydenstricker, Thomas D. Wood, Robert M. Woodbury, and Mrs. Ira Couch Wood.

The University of London is granting a new degree in Commerce which has attracted a very large number of students. The first group of candidates will proceed to their final graduation examination in the summer.

Professor Edmund E. Day has resigned his professorship at Harvard University, to take effect in February, 1923, in order to undertake new and more varied duties at the University of Michigan. The new appointment carries with it the titles of Professor of Economics, Chairman of the Department of Economics, and Director of the Curricula in Business Administration.

Dr. Frederick L. Hoffman, third vice-president and statistician of the Prudential Insurance Company, has accepted a position with the Babson Institute at Wellesley Hills, Mass. He is to be dean of the Graduate School of Business Administration, which is a new feature of the Institute. Dr. Hoffman took up his new duties the first of May, but he still retains his connection with the Prudential Insurance Company, and as far as is possible his services will remain available to the government, insurance companies, and other businesses, to labor, and to voluntary health and welfare promoting agencies.

Dr. Hoffman has recently returned from a seven months' trip across South America, undertaken for the purpose of scientific inquiry into problems of tropical mortality and their relation to insurance. As yet no publicity has been given to the results of his investigations.

Mr. J. H. Riddle, recently a member of the staff of the Statistics Department of the Federal Reserve Bank of New York and an instructor at Columbia University, is now chief of the Statistics Section of the Secretary's Office at the Treasury Department.

Professor Robert Riegel, of the Wharton School of Finance and Commerce, is to give a course in insurance and one in statistics at the coming summer session of Northwestern University.

Mr. Harry S. Fischer has been placed in charge of the Bureau of Statistics of the New York Transit Commission.

Mr. W. A. Berridge, instructor and tutor in Economics at Harvard University, has won the first of three prizes awarded by the Pollak Foundation for Economic Research. "Unemployment and the Business Cycle" was the subject of his essay.

## APPOINTMENTS ON COMMITTEES FOR 1922

At a meeting on February 16, 1922, the Board of Directors appointed the following committees:

Committee on Measurement of Employment: Mary Van Kleeck, Chairman; A. J. Altmeyer, C. B. Baldwin, W. A. Berridge, R. D. Cahn, F. E. Croxton, R. G. Hurlin, M. O. Lorenz, D. C. Lescohier, E. B. Patton, R. F. Phelps, W. H. Steiner, F. G. Tryon.

Committee on Business Research: F. Leslie Hayford, Chairman; Andrew H. Melville, First Vice-Chairman; W. L. Glenzing, Second Vice-Chairman; S. L. Andrew, L. P. Ayers, E. S. Bradford, R. C. Craig, C. S. Duncan, Earle Clark, L. K. Frank, J. E. Pogue, T. K. Stevenson, H. Parker Willis.

Committee on Institutional Statistics: H. M. Pollock, Chairman; Edith Abbott, Kate Halliday Claghorn, Edith M. Furbush, Joseph A. Hill, R. M. Woodbury.

Committee on Membership: Edwin W. Kopf, Chairman; Arthur R. Burnet, Robert E. Chaddock.

Committee on Program and Place of Next Annual Meeting: W. S. Rossiter, Chairman; L. P. Ayres, R. E. Chaddock, L. I. Dublin, W. F. Ogburn.

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## MEMBERS ELECTED SINCE FEBRUARY

Armour, H. Richmond, statistician, Pan-American Petroleum & Transport Co., New York City
Baird, Ralph P., Northwestern Bell Telephone Co., Omaha, Neb.
Bishop, Wilfred M., Statistical Dept., General Motors Corp., Detroit, Mich.
Dodge, Martin, Merchants Association of New York, New York City
Flinn, Harold M., American Tel. & Tel. Co., New York City
Forsberg, Allen B., Carroll College, Waukesha, Wis.
Fox, A. Manuel, lecturer, College of the City of New York, New York City
Goetz, Minetta-Marie, American Tel. & Tel. Co., New York City
Herendeen, Thomas G., American Tel. & Tel. Co., New York City
Hinkle, Helen H., American Tel. & Tel. Co., New York City
Jones, Mark M., 2702 Woolworth Bldg., New York City
Merchant, Ely O., G. H. Mead Co., Dayton, Ohio
Michener, S. M., American Tel. & Tel. Co., New York City
Oglesby, Earnest J., Dept. of Mathematics, New York Univeristy, New York City
Rankin, Francis B., American Tel. & Tel. Co., New York City
Rollins, Harold E., Asst. Statistician, Dennison Mfg. Co., Framingham, Mass.
Tanner, John B., president of Tanner-Gilman School, Inc., Chicago, Ill.
Weaver, Spencer E., graduate student, Columbia University, New York City

# REVIEWS

*Grundriss der Statistik*, by Franz Zizek. Munich and Leipsic: Duncker and Humblot. 1921. viii, 470 pp.

Statistics as an academic discipline probably owes more to Germany than to any other country. The word, in the scholar's lingua franca of medieval Latin and later in the vulgar tongues when scholars condescended to employ them, though probably originating in Italy, was German in its early currency. For almost two hundred years, from the day of the Elzevir Republics until early in the nineteenth century, statistics held in German universities a position of honor and importance to which elsewhere it hardly attained. One of the two dominant currents of development throughout that period was so centered in the universities that it has been called German university statistics, a kind of descriptive political science exemplified by what the *Statesman's Year-Book* would be if stripped of its numerical or statistical statements.

During the following century, although the German conception of statistics changed into a closer resemblance to English political arithmetic, yet its hold on the German universities seems to have been little affected thereby. Naturally enough, although the content of statistical textbooks has changed, the literary output in Germany has continued unabated. Probably in the last generation it has equalled that of any two or three other countries. The present work challenges comparison with its predecessors and contemporaries in Germany, and its contemporaries (there are few predecessors) in other countries.

The most spacious survey of statistics ever conceived and carried well toward completion (I exclude Sinclair's *Statistical Account of Scotland*, as I do many sets of census volumes) is doubtless von Mayr's *Statistics and Social Science*, originally planned for two volumes but already filling three, although it has not yet touched the wide field of economic statistics. These three volumes, which have required more than a quarter of a century for their production, occupy nearly two thousand octavo pages. Other and briefer German surveys of this field are found in the fourth part of Conrad's *Outlines of Political Economy*, in Bleicher's *Statistics*, and in Schnapper-Arndt's *Social Statistics*. For England there is Giffen's *Statistics;* for the United States, Mayo-Smith's two volumes. These are the works with which the present publication naturally invites comparison. Other books like those of Newsholme, Bowley, Yule, King and Secrist represent a different view of statistics or are restricted to a relatively narrow field.

Professor Zizek has two objects in mind, one scientific, the other practical. The scientific object is to tie the theory more closely to the practice than previous writers have done. They have treated each branch of statistics by itself with little relation to coördinate branches or to the main trunk of theory; he writes both to prove and to illustrate the interrelations between one branch and another, and the dependence of any one branch upon certain general principles common to all. His practical object is to supply German students of the social sciences with a brief and clear summary of statistical method, and of the main results secured by using this method in the study of mankind, particularly Germankind.

The book, accordingly, is in two parts: first, the theory and technique of statistics, or the general theory of statistical methods; and, second, material statistics, or the special theory of particular methods and a presentation in systematic fashion of the study's main results.

His general point of view appears in his discussion of mathematics and statistics. The preface states that his book, though touching on the fundamental principles of mathematical statistics, does not cover that field, which presupposes a knowledge of advanced mathematics not usually possessed by students of social sciences for whom he writes. In the body of the work he speaks of mathematical statistics as a special development within the field of statistical methods, applying the calculus of probabilities and the theory of errors. It is often contrasted with elementary statistics which uses only the simplest forms of computation. But such a contrast is one of technique, not of substance. The fundamental principles of mathematical statistics, such as the law of large numbers and the distinction between general causes and accidental disturbing causes, lie at the root also of elementary statistics. Both investigate the uniformities of statistical series, the distribution of single cases around an average, and the degree of correlation between several series. Mathematical statistics with its more refined methods can handle such problems with the greater precision. But the results of elementary statistics usually suffice for the investigations of sociology and economics, and in many such fields there is no need of going further: indeed, the conditions for resorting to mathematical statistics may be lacking. For these reasons the importance of mathematical statistics in the general field of statistical methods is theoretical rather than practical.

He ends the first part of the book with an answer to the question, Is the statistical method a species of induction? Eulenberg says yes; Tschuprow gives it an independent position coördinate with induction; Reichesberg, whom Zizek follows, maintains that induction infers the presence of a characteristic in all members of a group from its observed presence in many members, and thus generalizes. He also maintains that statistics refuses to make a similar assumption, asserting that by its principles no generalization from many members to the group is warranted and every member must be observed. The statistical method thus applies where it is inadmissible to infer inductively from the separate case to the whole group, or deductively from the whole group to the separate case. Reichesberg rightly maintains that the essential characteristic of the statistical method is the elimination of the unimportant, secondary, or individual causes through invoking the law of large numbers under which they will cancel.

To illustrate his handling of a specific statistical problem, I have chosen Professor Zizek's discussion of unemployment, the burden of which is so great as to call for statistical measurement. The condition of the labor market, the progress of an economic cycle, the amount of overpopulation, or the need for planning relief measures may be inferred from the number of the unemployed. This group should be analyzed by various characteristics such as sex and age, and by the duration of unemployment. The methods used in measuring unemployment are:

1. A census of the unemployed taken in connection with a census of population or of occupations. This has the advantage of completeness but the disadvantage of occurring only at long intervals and then perhaps at an unsatisfactory time.

2. A separate census of the unemployed taken at a period of depression or when means to care for unemployment are being considered.

3. Returns from trade unions giving the number of their members out of work or receiving out-of-work relief. The best measure of unemployment obtained from this source is the proportion of members out of work to all members. But unemployment depends upon the time one is out of work, and the best theoretical measure is the ratio between the number of idle days and the number of member days or possible labor days.

4. Those receiving public out-of-work relief are enumerated and the number reported. A distinction is drawn between those entirely out of work and those working on part time. The amount paid in relief and the cost of service are also given.

5. Employment agencies report the number of persons registering as in need of work. But the same person may register at several places, or when he registers may be at work of an unsatisfactory kind. On the other hand, when unemployment is greatest people may become hopeless and fail to register.

6. Statistics of paupers and of tramps throw some light upon the amount of unemployment.

7. Some cities maintain relief work for the unemployed and publish statistical information about them.

Professor Zizek's new book no doubt will prove of great value to German students of statistics. The first part dealing with the theory has a value less limited by lines of nationality. This part of the book might advantageously be translated and published for American students; or, better yet, a book might be prepared based upon this but substituting American material for the prevailing German data.

Walter F. Willcox

Cornell University

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*Waste in Industry*, the Report of the Committee on Elimination of Waste in Industry. New York: McGraw-Hill Book Company. 1921. xii, 409 pp.

The Federated American Engineering Societies came into being toward the end of 1920. One of the first acts of the president, Herbert Hoover, was to recommend a study into the restrictions and wastes in industry. Such a study was authorized by the executive board, and in January, 1921, fifteen engineers (whose principal interest was management engineering) were appointed as the Committee on Elimination of Waste in Industry. Two additional members were appointed later.

It was decided that the study should be in the nature of an assay or reconnaissance, carefully planned and rapidly executed. Both the findings and the method of investigation should be appraised in the light of this decision. In less than five months six typical branches of industry had been assayed and a preliminary report rendered. The volume before us is the unanimous final report. It is a volume of extraordinary significance with respect to findings and method.

With respect to the findings, which the press has made familiar, the following summary table (p. 9) will suffice:

| Industry studied | Responsibility[a] for waste assayed against | | |
|---|---|---|---|
| | Management | Labor | Outside contacts[b] |
| | Per cent | Per cent | Per cent |
| Men's clothing mfg. | 75 | 16 | 9 |
| Building industry | 65 | 21 | 14 |
| Printing | 63 | 28 | 9 |
| Boot and shoe mfg. | 73 | 11 | 16 |
| Metal trades | 81 | 9 | 10 |
| Textile mfg. | 50 | 10 | 40 |

[a] "Responsibility" as here used does not mean moral responsibility for the waste, but opportunity to remedy the conditions.
[b] Signifies the public, trade relations, etc.

The waste discovered in the six industries studied was attributed by the committee to: (1) Low production caused by faulty management of materials, plant, equipment, and men; (2) interrupted production caused by idle men, idle materials, idle plants, and idle equipment; (3) restricted production intentionally caused by owners, management, or labor; (4) lost production caused by ill health, physical defects, and industrial accidents. The point of view obviously was that of the engineer, *i. e.*, the waste due to failure to utilize fully the potential labor, material, and organization power in existing plants. No special inquiry was made into the possible waste from such sources as the social organization of industry or the over-equipment of an industry.

The method of investigation is of especial interest. The first step, the selection of the personnel of the committee, is logically a phase of the method, for apparently Mr. Hoover perceived that the only practicable method in detail for a rapid assay depended for its effectiveness upon the experience brought by the individual members of the committee to their task. The committee was therefore made up chiefly of management engineers who had had experience in developing the best management methods in individual plants, who had employed the methods of objective science in their practice in working out detail standards of good management, and who could bring these standards into the work of the committee as standards of appraisal of waste in the reconnaissance.

This point cannot be overemphasized. For the committee to employ the methods of objective science in its work was impossible in a study of five months—or five years, or fifty years. Study of industry on a large scale does not lend itself to such methods. The only possible method was to match observed performance against predetermined standards. The predetermined standards had to be as nearly as possible standards determined by previous studies in detail by the methods of objective science. The most signal individual achievement in the course of the investigation was Mr. Hoover's selection of the committee. For the purpose, it could not have been equaled by any other available group.

The committee proceeded first, bringing together individual past experiences, to construct an "Evaluation Sheet"—a code of standards. Standards were divided into three grand groups—Organization, Technical, and Utilization. These were weighted by the assignment of points totaling 100. Each of these groups was subdivided into sub-groups, each sub-group standard having a weighted value; and these sub-groups were again subdivided, each standard of a sub-sub-group having a weighted value. This scheme of weighted and valued standards was set up in the form of a "questionnaire"—not really a questionnaire, but a set of guide questions for field investigators.

Plants were then inspected with respect to each standard in the scheme, and with respect to each standard were given a value according to the degree the observed condition of management approached the value assigned the standard. The value of the standards were then summed up and the plant given a rating for Organization, Technical Methods, and Utilization, and these were summed up into a rating for the plant, all values being reduced to percentages. When appraising the plant with respect to each standard, the investigator appraised also the responsibility for the conditions indicating waste, whether attributable to (*i. e.*, remediable by) management, labor, or outside influences.

It is obvious, therefore, that the method is the method of empirical judgment with respect to the setting up of a code of standards, the appraisal of the condition found against a standard, the assigning of values, and the apportionment of responsibility. But the significant thing is that back of these standards and entering into their determination is a large amount of research into management methods according to genuinely scientific methods; and, further, that seventeen engineers, independent in their experiences, in some respects rivals in their theories, agreed upon the code of standards and upon the results of the investigation. The method of empirical judgment is not always to be sneered at; it depends upon by whom, and for what purpose, and under what circumstances it is employed, and how many independent competent observers are in agreement in the judgment. A skilled buyer of cattle on the hoof can "guess" within a few pounds the weight of a steer; a skilled timber cruiser can "guess" with surprising accuracy the millions of feet in a tract of timber. Some "guesses" have in addition to experience an ancestry of scientific methods of investigation.

The committee is under no illusions concerning its method and the result. We find (p. 118) the following: "We feel that the chief value of this field report evaluation sheet is to be found not in the results of this investigation, but in that it constitutes an important *beginning* out of which will be perfected a very powerful and very valuable instrument for investigation." Also: "We are fairly well satisfied that our evaluation sets forth the *comparative* wastefulness of the . . . plants with substantial accuracy . . . too much reliance should not be placed upon the absolute accuracy of the several evaluations."

Incidentally the book will be found to be one of the best books of reference, possibly one of the best texts, for the teaching of management.

H. S. Person

Taylor Society, New York

*Cycles of Prosperity and Depression in the United States, Great Britain, and Germany: A Study of Monthly Data, 1902–1908*, by Alvin Harvey Hansen. (University of Wisconsin Studies in the Social Sciences and History, No. 5.) Madison. 1921. 112 pp.

Professor Hansen has developed an interesting variant of the statistical attack upon business cycles. He confines himself to the study of a single cycle, collects all the statistical series covering it that are readily available in monthly form, eliminates the secular trends and seasonal oscillations, reduces the "cyclical fluctuations" to terms of their standard deviations, and, finally, computes coefficients of correlation among the series in this refined form. The influence of Professor Warren Persons upon the technique of the investigation is obvious.

The first result of the work is to divide the 23 American series dealt with into three groups according to the time relations among their cyclical fluctuations:

> The Investment Group includes series that anticipate general prosperity or depression and are related to the investment market. The Industrial Group includes those series which constitute the very essence and substance of prosperity and depression; it is the touchstone, the barometer of good and bad times. The Banking Group represents the monetary and credit facilities, the tools and instruments of the modern business mechanism. (Pp. 22–23.)

From each of these groups Professor Hansen selects from three to five series that are substantially synchronous in their oscillations, and makes them into what he calls Investment, Industrial, and Banking "Composites." Taking the highest coefficient of correlation obtained from computations made for varying lags as his base line, he finds that the Banking Composite (the revenues, deposits, and loans of New York clearing-house banks, plus call-loan rates) precedes by twelve months the Investment Composite (prices of 10 investment and 40 railroad stocks, shares sold in New York, and liabilities of business failures), while the latter precedes by eight months the Industrial Composite (commodity prices, pig iron output, railroad gross earnings, imports and immigration).

Next Professor Hansen makes Banking, Investment, and Industrial Composites for Great Britain and Germany. He finds that the American Banking Composite precedes the European series slightly; that there is very close correlation between the American and British but not between the American and German or the British and German Investment Composites, and that the Industrial Composites in the three countries move in close agreement with each other. He does not inquire whether the relations found among the cyclical fluctuations of his three composites in the United States hold among the three composites in Great Britain and among the three in Germany.

Turning, finally, to "The Theory of Prosperity Cycles," Professor Hansen asks whether the trouble that culminates in crises begins with a decline in the demand for consumers' goods, or whether "the initial diminution of demand is on the part of business men for producers' goods." To decide this issue he compares the fluctuations in the prices of consumers' and producers' goods in the United States from 1902 to 1908. For consumers' goods he averages the Bureau of Labor Statistics group index numbers of food, clothing, and house furnishings at wholesale, and for producers' goods he makes similar averages from the group index numbers of metals and implements and lumber and building materials. As a further test he compiles special German index numbers including 16 producers' and 14 consumers' commodities. The results are clear: "In both countries the prices of consumers' goods begin to decline about seven months after the decline in the prices of producers' goods." (P. 98.) Nor does he find any evidence "that the prices of producers' goods fall because of a diminution in the *rate of increase* in the prices of consumers' goods." (P. 102.) "In fact, so far as the United States is concerned, the rate of increase appears if anything to increase after the fall in the prices of producers' goods," and in Germany consumers' goods rose as rapidly in April–August, 1907, as in June–October, 1906. "In short," he concludes, "the theories emphasizing consumers' demands do not appear to harmonize with the statistical facts." (P. 103.)

The "fundamental cause of the business cycle," in Professor Hansen's view, lies in the economic effects produced by the extension of bank credit:

> The issuance of bank credit simply redistributes purchasing power, reducing the real purchasing power of income receivers generally, and increasing the purchasing power of entrepreneurs able to secure bank credit. It is this redistribution of purchasing power, accomplished through the instrumentality of banking institutions, that changes demand, upsets prices, affects the profit margin, and therefore production. . . . The magnetic force which draws out the extensible bank credit is the entrepreneur's anticipation of profit. . . . So long as bank credit continues to be capable of further expansion, prices continue to rise. This upward movement comes to a close only when bank credit can no longer be further extended for the reason that it has already reached the limit of banking safety. (Pp. 106–7.)

This analysis is confirmed according to Professor Hansen by his statistical results. For, as said above, the earliest movements in the business cycle are those of the Banking Composite.

Such is the gist of a little book which every one concerned with the subject will find suggestive and inconclusive. We may hope that Professor Hansen plans to rewrite his chapters on a more liberal scale and with a more critical treatment of his data. It is dangerous to base broad conclusions on the study of a single cycle. For example, a comparison of the price fluctuations of consumers' and producers' goods in 1919–20 might yield results very different from those which Professor Hansen (and the present reviewer) have drawn from 1906–07. Further, in dealing with this topic the investigator should scrutinize his material narrowly to see whether his list of consumers' goods does not contain a preponderance of farm products, and his list of producers' goods a preponderance of mineral and forest products. If such is the case, the results may not justify the construction Professor Hansen puts on them. Once again, if Professor Hansen knew the erratic way in which the import and export statistics of the United States have been compiled in the past he would not have wasted his time in computing coefficients of correlation based on the monthly returns. Finally, Professor Hansen's three "Composites" represent a geographical difference as well as the difference between banking, investment, and industry. Every series in the Banking Composite reflects conditions in the great clearing-house banks of New York City, and every series in the Investment Composite, except "liabilities of business failures," represents conditions on the New York Stock Exchange.

His Industrial Composite, on the other hand, represents conditions in the country at large. Hence the conclusions which his figures justify are not conclusions about the precedence of banking over investment and investment over industry, but are at best conclusions about the precedence of banking in the financial center over investment in that center, and the precedence of investment in the financial center over business operations at all ports of entry and throughout the interior.

Wesley C. Mitchell

National Bureau of Economic Research

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*General Accident Statistics for Wisconsin*, Industrial Commission of Wisconsin. Madison. 1921. 124 pp.

Wisconsin was one of the earliest states to adopt Workmen's Compensation, its act dating from 1911. The Industrial Commission of Wisconsin has always been distinguished by ability, and it is one of the few administrative boards in the United States which has consistently maintained a competent statistical department. Wisconsin, accordingly, holds a place of well-deserved leadership in the output of accident statistics.

The present document is the first comprehensive tabulation of work injuries issued by the Industrial Commission since 1915. It covers all compensable injuries adjudicated in the period 1915–20, but the more detailed tables are limited to cases settled in 1920. The publication is a special number of the *Wisconsin Safety Review*, and gives particular attention to *cause* in correlation with *severity* of injury. There are tables of cause and severity for all industries, 1915–20, for all industries, 1920, and for metal working, paper making, logging and lumbering, mining and quarrying, and building industries, 1920. The classifications and scheme of tabulation in these tables are those recommended by the statistical committee of the International Association of Industrial Accident Boards and Commissions, and the work is admirably done. There are also tables of compensation cost by severity of injury, part of body and duration of disability, and a frequency distribution of the weekly earnings of injured workmen. Especially useful are the detailed exhibits of permanent partial disabilities not amounting to loss or loss of use of members (Table XI), and of the healing period, or duration of temporary total disability, in connection with permanent partial disabilities (Tables XIII and XIV).

Of special interest and value are the estimates of relative accident frequency and of total accident severity. Relative frequency was plotted from the reported number of compensable injuries and an index number of employees obtained from reports to the employment division of the Industrial Commission. The curve shows a sharp rise of accident frequency in 1916, another in 1918, and a third in 1920, with a slight dip in 1917, and a marked dip in 1919. It is notable that the low point of 1919 was 150 as compared with 115 in 1915. Total severity of industrial injuries is expressed in days lost by the use of standard weights for deaths and permanent disabilities recommended by the International Association of Industrial Accident Boards and Commissions.

Total severity is a ready index of the relative importance of specific causes of injury, and the severity rate, obtained by comparing total severity with number of employees, is the best possible index of the accident hazard of specific industries.

The format of this document is good, the table headings are clear, and the several charts and graphs are really useful. No time or space has been wasted upon irrelevant matter, nor upon beautiful but meaningless designs. The only criticism to be offered is that much highly useful material was omitted. Considerations of expense, enforced by inadequate appropriations, doubtless caused the omissions, yet the added cost would amount at most to a few thousand dollars per annum.

The most serious omission is the failure to give exposures in correlation with the number and severity of injuries. The Industrial Commission has jurisdiction over both insured and uninsured employers and is in position to obtain at least the pay-roll of every employer subject to compensation. Employers who are permitted to carry their own risk can be required to report pay-rolls in such detail as the commission may prescribe, and insurance carriers can be compelled to report pay-rolls by individual risks in Wisconsin as well as in Pennsylvania. The pay-roll is not the best basis for computing accident severity rates, but it is the only basis attainable in any jurisdiction, American or foreign. Total pay-roll, divided by the average weekly wage obtained from accident statistics, will even give a closer approximation to the actual number of employees exposed than can ever be obtained from the employers' reports of the numbers employed.

The industry groups in this document are too few and too comprehensive—logging, saw milling and furniture manufacturing, *e. g.*, are by no means a homogeneous aggregate. It is unfortunate too that the industry tables cover only a single year; the five year period would give a broader exposure and more representative averages. Lastly, there should be far more detail as to the *nature* in correlation with severity of injuries.

With all these sins of omission the publication under review is much the best extant compilation of accident statistics for a large industrial community. *General Accident Statistics* reflects great credit upon the Industrial Commission and its statistician.

E. H. Downey

Pennsylvania State Workmen's Compensation Commission

*Family Budgets of American Wage-Earners: A Critical Analysis.* Research Report No. 41, September, 1921. National Industrial Conference Board. New York: The Century Company. 97 pp.

This report presents a brief summary of facts about nearly all the important budget studies of wage-earners' families in America. Readers are already familiar with summaries of budgets published by the Bureau of Applied Economics. This study is somewhat more analytically critical, however, and less a detailed presentation by items of the different budget studies. The facts reviewed are incomes, expenditures, percentages spent for food, clothing, rent, fuel and light, and sundries; sizes of families, income classes, dates, places, investigators, etc., for the various investigations of the last quarter of a century. In addition there is a short history of the use of family budgets in wage disputes. Woven around the facts and their classification are interpretive estimates of their value and use.

In popular usage there is much confusion about the cost of living. The report calls attention to the difference between the change in the cost of living and what the cost of living is. It also differentiates the minimum subsistence level from the minimum comfort level, a differentiation frequently not made in wage adjustments. The report also attempts to show the difference between budget studies which are simply records of actual expenditures and budget studies that are estimates of standards of what ought to be spent. These two types of budgets are quite different things, serving different purposes, although they are interrelated and a good estimate of a standard can be made only after a study of actual expenditures. Obviously, the two types of budgets may be made at either the minimum subsistence level or the minimum comfort level.

It seems to me that this last differentiation is not always kept clearly in mind by the author, and that this is one reason for the harsher criticism of the minimum comfort budgets. The author recognizes in the conclusion of Chapter II that estimates of standards at the subsistence level are based on actual records, but seems not to recognize this basis as true at the comfort level discussed in Chapter III. "In the present chapter are reviewed the best known of the attempts to estimate the cost of living made without collecting incomes and expenditures from actual families." (Page 33.) Seldom before has there been so much good material on "incomes and expenditures from actual families" as was collected by the United States Bureau of Labor Statistics. Most of the data were for the minimum comfort level and served as a basis for estimates of standards made at this level. Also, many estimates reviewed in Chapter III were based on actual records of expenditure. Again, in estimating the minimum comfort budgets: "The minimum comfort budgets on the other hand represent ideal conditions. . . ." (Page 50.) The minimum comfort budgets are simply standard estimates at a higher level than the standard estimates at the subsistence level, and would not be admitted by the investigators who made them or by the wage-earners as representing ideal conditions.

In Chapter IV the author presents research to show that the size of the family used in estimates of standard budgets—five persons—is not typical of the country or locality. This research on the actual size of the family is interesting but, it is thought, not particularly relevant to setting a standard. The average size of the family in a particular locality may be less than five, but a standard would hardly be drawn up for less than five. Public policy would not sanction a smaller family, for two children must grow up to replace the parents, else the population decreases; and since the chances of death for children are great, provision must be made for more than two children. Mr. Rowntree's researches on this point show a practical justification for this procedure. The following quotation seems to be another indication of a possible confusion of the actual and the standard. "Instead a family of five . . . was taken as typical of the American wage-earner." (Page 71.) I doubt if the author could cite but few if any instances where the framers of standard budgets claimed that the family of five was taken as "typical." It is taken as a minimum standard but not as actual or typical.

Frequently the point is made in the report that families studied in surveys were selected and not chosen at random. The idea that selection prevents representativeness and that purely random selection is a desideratum needs qualification. A mere haphazard choice of families would itself turn out to be a selection; in reality the samples must be selected in order to yield the desired representativeness. And if the purpose of a survey is to determine a standard, cases are selected to throw light on the standard. If a standard is being set up for families without boarders, why collect data on boarders?

The report is scholarly. There are abundant footnotes. The facts and data are accurately listed. There is evidence of carefulness. Any departure from science, rather, any bias in the report, would show only in the interpretations and in the selection of material to be presented. For instance, this report of the National Industrial Conference Board nowhere presents a budget in detail showing how many shoes or dresses or hats are bought, or how much is spent for recreation or for doctors. The method here is to present only such summaries as "40 per cent of the income is spent for food." This procedure is, of course, quite within the right of the authors, and to have done otherwise might have marred the nature of the study or not fitted in with its scope. This method of presentation leaves the reader less impressed with the human significance of the standard of living than if, for instance, the report read,"the budget allowed the purchase of one straw hat every other year at $2." In the analysis and collection of budgets by organizations supported by wage-earners, budgets are given by items because these organizations wish to get across the human meaning of the budget. Different methods of presentation leave various effects as truly as do data and facts. For instance, what the National Industrial Conference Board calls the "American minimum," the wage-earner will call "bare subsistence." In any statistical work there is always room for the subjective; as a matter of fact, it is very difficult to make any interpretation free from bias. This report, as reports go on controversial and emotional issues, is exceptionally free from subjective distortion, and would be quite generally rated as a clear, useful presentation.

William F. Ogburn

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*Farming Costs*, by C. S. Orwin. Oxford University Press. 1921. 141 pp.

This little book, a revision of an earlier work entitled *The Determination of Farming Costs*, consists essentially of an outline of a method by which cost accounting can be applied to agricultural operations, a brief but penetrating discussion of the fundamental problems that arise in this field of cost analysis, and a statement of the principal results to be obtained from such accounting. It appears to be based largely upon investigations conducted by the Institute for Research in Agricultural Economics, of which Mr. Orwin is director.

In the introductory chapter attention is called to the more patent advantages of stock-keeping and costing in the conduct of a manufacturing establishment, and it is pointed out that as yet little effort has been made to place farm management upon a similar statistical basis. In this connection the fact that the determination of costs in agriculture is a problem involving peculiar difficulties is rightly emphasized, and no unreasonable claims are made with respect to the possible results to be obtained from such work. The author does not suggest that every small farmer should install an elaborate system of accounts. He admits the propriety of the view that in many cases "managerial functions can be exercised most profitably in the field." On the other hand, he insists that a thorough analysis of farm costs in even a few representative cases should furnish valuable standards for comparative purposes and should facilitate the solution of underlying agricultural problems.

In beginning his discussion of procedure Mr. Orwin first contrasts the "synthetic" and "analytical" methods of approach, and very properly decides that the only cost data of significant value for managerial purposes are the *actual* costs—as nearly as they can be ascertained—and not hypothethical costs based upon selling prices adjusted with reference to an estimated rate of return upon investment. It is refreshing to find this clear-cut stand against the inclusion of interest or other income elements in a calculation of cost from the point of view of the individual establishment or business. Here the author also takes occasion to repudiate price-fixing as the primary object of cost accounting. He avers that it is the essential function of such accounting "to provide an analysis of cost so that waste may be detected and so that the manager may be able to consider means for effecting economies in production by an examination of cost at all stages." Such conservative views are a pleasing contrast to the pretensions of the typical cost enthusiast.

The entire book, in fact, is especially noteworthy because of its many excellencies with regard to points of view applicable to all branches of cost accounting and the acute observations it contains on fundamental questions of principle arising particularly in the determination of farming costs. Mr. Orwin throughout shows keen appreciation of crucial problems and a willingness to face them squarely. His work is a consideration of underlying theories even more than it is an explanation of practical procedures or a compilation of statistics.

In outlining a procedure for the determination of agricultural costs the author discusses the principal books, records, and classifications which he believes should be employed. He describes various "stock books," "implement and machinery records," "time sheets," etc. For purposes of cost classification he decides upon the *field* rather than the *crop* or the *operation* as the most important primary accounting unit, giving as a principal reason for the adoption of this plan the statement that "there are few crops which do not inherit some benefit from their predecessors, or which do not hand on some unexhausted value to their successors." Thus the costs of labor, fertilizer, seed, etc., are charged to the particular field account, an appropriate part thereof being later transferred to an intermediate "dead stock" account when a crop is harvested. The principal classifications for live stock are also discussed, and it is suggested that the cost of fodder consumed should be divided between the live stock and the fertilizer accounts on the basis of the value of food residues as worked out by certain standard authorities. Evidently, arbitraries must be used in such procedures to a serious extent, and hence a mild skepticism as to the validity of the resulting costs is perhaps pardonable. In the opinion of the reviewer there is much to be said for a system for the ordinary case which ignores the cost of fertilizer produced on the farm, and does not call for an apportionment of labor, fertilizer, and other costs between a succession of crops.

Numerous forms are exhibited. Most of these would require modification for use by the American farmer. The implement register shown on pages 20–21 is cumbersome and inadequate. The use of a series of year columns, in each of which is shown the balance of each class of equipment after depreciation for the preceding period has been deducted, is quite unnecessary. Such a register should show the date of purchase, the cost, the estimated service life and depreciation rate, and, ultimately, the date of sale or abandonment and the sale or salvage value. The estimated accrued depreciation can then be accumulated in a controlling contra account; and no reconciliation with respect to the implement book is required until a unit is finally disposed of. In this connection Mr. Orwin's "limit of depreciation" theory may be said to be somewhat unreasonable. The farm manager should decide upon a service life and then prorate the total depreciation evenly over this period. To fix in advance a figure beyond which it is assumed there will be no depreciation, and which will be reached perhaps years before the end of the estimated service life, is surely a questionable procedure.

Chapter III, in which a series of difficult and disputed questions are considered, is the most interesting part of the book. The first of these questions is valuation. Mr. Orwin insists that actual cost is the only proper basis for the valuation of unsold produce, live stock, and other items. He vigorously denies the validity of the market as a valuation test. From the standpoint of the cost accountant this position is doubtless quite reasonable, but there is much to be said on the other side as far as general accounting and the preparation of the income sheet and statement of financial condition are concerned. Our Treasury Department now permits farmers to value unsold produce for income tax purposes at selling price less estimated marketing costs, or in other words, to "take their profits" in the year in which the crop is produced rather than in the year in which it is marketed, assuming the two to be different; and in view of the difficulties in the way of accurate costing for the average farmer, and the especial importance of the market in the case of staple farm products as an indication of true financial position, this ruling is to be commended.

Mr. Orwin insists on the importance of recognizing depreciation in the case of draft animals, although he apparently denies that dairy stock can so decline in value. His suggestion that the cost of pedigreed stock should be divided between ordinary cost and pedigree value (a value somewhat analogous to that of patents) is interesting but rather bizarre.

The discussion of the valuation of intermediate products (pp. 43–46) is especially good. The author points out that the farmer does not sell oats and hay to his live stock and that he is not justified in assuming that any such transaction occurs. It is in this case that valuation on any but a cost basis is especially questionable, and Mr. Orwin makes the most of the opportunity to demonstrate this fact. Three ways of dividing "joint" costs are mentioned. One possibility is a separation on the basis of the proportion indicated by the market prices of the joint products; relative "food values" give a basis for a second method; the selection of a main product and the use of any sales of the by-product as a reduction in the cost of the principal result is a third plan, and the one now favored by the author.

Mr. Orwin suggests that general or "establishment" costs should be apportioned on the basis of the sum of manual, horse, and tractor "labor" charges. Such apportionment, he feels, is preferable to none. A curious definition of rent as interest on capital may be noted in this connection (pp. 55–56).

In Chapters IV and V the results to be obtained from cost analysis on the farm are stressed and a considerable number of tables based on actual investigations are exhibited. These show unit costs of horse labor, mechanical power, etc., and of crops of various kinds, for certain cases which have been studied by the Institute. The importance of the more general data which may be derived is emphasized. Tables indicating output per man, per acre, etc., are presented. There is some discussion of the fundamental problem of combining proportions. Data are offered, for example, which suggest that the number of laborers and the output per hundred acres vary inversely with the size of the farm, and that the output per man varies directly with the holding. These tables, it may be noted, are not always arranged to the best advantage, and appear to be seriously inaccurate. In the one on page 101, for example, the designation "total" is attached to the footings, but the last two are clearly intended to be averages. Further, the arithmetical averages of the amounts shown in these last two columns are $837^3/_5$ and $273^4/_5$ rather than 814 and 287 respectively—the numbers given. Similarly, on pages 102 and 103, where the term "average" is used several times, the figure given is in no case even an approximate average of the various amounts involved. The discrepancies are so serious that it seems evident that Mr. Orwin must have some special method of calculation, not properly known as averaging, and with the mysteries of which he does not acquaint the reader.

Other problems mentioned upon which the writer believes light may be thrown by means of data drawn from accounts are the relation of labor cost to earnings per man and the cost of living, and the distribution of the net returns of farming among tenant, laborer, and landlord. A study tending to show the extent to which the small farmer can profitably use machinery would have been interesting. There is some evidence that American farmers are loading the small farm with more equipment than it can economically support.

The very extensive bibliography appended is a valuable feature of the book.

Mr. Orwin, despite his conservatism, is perhaps unduly optimistic with respect to the development of accounting and the use of business methods in agriculture. One finds it hard to picture the typical Michigan farmer, for example, attempting to introduce any system of accounts even remotely approaching the rather elaborate scheme suggested in this book; and the reviewer feels that it is very doubtful if it would be expedient for him to make the attempt. The difficulties in the way are inherent and serious. Possibly something can be done in this direction if the farmer's wife can be induced to add bookkeeping to her already too numerous tasks.

W. A. PATON

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*Army Anthropology* (Part I of Vol. 15: Statistics: The Medical Department of the United States Army in the World War), prepared under the direction of M. W. Ireland, Surgeon-General of the Army, by Charles B. Davenport and Albert G. Love. Washington. 1921. 635 pp.

This volume presents the anthropological data on recruits in the World War and is a companion volume to that entitled *Defects Found in Drafted Men*, prepared by the same authors in 1920 for the Surgeon-General's Office, War Department. The volume is a very complete analysis of the anthropological measurements on 1,000,000 recruits, on 100,000 men at demobilization, and on a large number of men showing certain physical defects.

The height, weight, and chest circumference were taken on the first 1,000,000 recruits. The mean values for the army as a whole and for groups of men from various sections of the country were compared with the Civil War records. As the authors point out, these facts cannot be used as an indication of the change of build in American young men because of the great influence of subsequent immigration. Comparison is also made between recruits from the individual states of the United States and also from the various sections of the country as characterized by occupation or type of population. This may possibly serve as a background for studying and perhaps understanding the variation from the mean for recruits from various sections. Comparison between the recruits at mobilization and at demobilization showed an increase in all three measurements over the latter group.

The most interesting comparisons, however, are those made between men of different nationalities—English, French, German, Hebrew, Irish, Italian, Polish, and Scotch. The tallest race are the Scotch; their mean height (67.93 inches) is almost 3 inches greater than that of the shortest race, the Italians (65.03 inches). The standard deviation for each nationality was about $2^1/_2$ inches. The mean weight ranged from 148.20 pounds for the Germans down to 137.85 pounds for the Hebrews. The significant fact was found that the Mediterranean races and the Hebrews have a greater chest girth in comparison with their height and with their weight than do the Nordic races. This may help to explain the very favorable condition of vigor of these two races.

The three measurements of height, weight, and chest circumference are important for selecting recruits for the army, but more important still, in the opinion of the authors, is Quetelet's height weight index, $\frac{\text{Wt} \times 1000}{\text{Ht}^2}$. This index "tells us something about the physical constitution of a man, and, by implication and as a result of experience, also something of his ability to withstand the stress of warfare. . . . In fact, it is not too much to say that the principal reason for taking weight in connection with height is to secure a numerical statement of the build as a first means of deciding upon the acceptance or rejection of the recruit for military service." This index, however, ranges from 36.5 for the short men to 28.6 for the tall men, because the weight does not increase at so great a rate as the height squared. Just what does this index indicate, and what is its range of variation compatible with good constitution? For men under 70 inches the index for the World War veterans, because of their greater relative weight, was higher than for the Civil War soldiers, and the authors conclude that the soldiers in 1919 were more robust.

But what are the limits of this beneficial extra weight? In studying men from various states and sections of the country and men with specific impairments, the data are not subdivided by age, but the index is computed for the group as a whole. If we may still assume that a higher index indicates a better constitution, we find that men with flat feet, varicose veins, hypertrophic tonsils have a better constitution than the recruits for the World War. Obviously, there are some limitations to the use of this index. Too much is claimed for it. A man of any height with corresponding average weight may be said to have a good build, but it is yet to be proved that his constitution and power of resistance are necessarily good. The results must be interpreted with great caution.

The authors use another index for robustness known as Pignet's formula [Height in cm − (chest in cm + wt in kg)]. The lower the index the better the constitution. This formula is founded on Pignet's argument that chest girth increases with height and also with weight, that the three quantities increase in such a way that in the normal person the index obtained by applying the formula will be a constant. We know that these measurements give wide variations. In fact, on these data the variations are so great that 65 per cent of the recruits over 5 ft. 7 inches do not measure up any higher than the majority of the groups showing impairments.

Eighteen special anthropologic measurements were taken on 100,000 men at demobilization, and comparison is made between the white and negro troops. Though the average height of both groups is about the same, the average weight is a little higher for the negroes. In the main, the negroes have relatively longer appendages, shorter trunk, head, and neck, broader shoulders, narrower pelvis, and greater girth of neck and length of thigh and calf than the white troops. The white troops seem more powerfully developed than the negro in the chest and less powerfully developed from the pelvis down.

The second section of this volume deals with the measurements of height, weight, and chest circumference and the interrelation of these three measurements of recruits found with various impairments including organic, functional, and physical abnormalities. The possible reasons for deviation from the normal are fully discussed. In studying these statistics it is important to consider the race in relation to the disease. For example, the group having myopia shows a relatively low mean stature as compared with other impairment groups. This is not because short stature causes myopia, but rather because this group is largely composed of Polish Jews whose mean stature is low even among the normal population. This combination of two dissimilar classes gives results with high variability. Where size and defect interact as cause and effect, the coefficient of variability is low. This must be taken into account in studying these diseases in connection with bodily measurements.

The mean values of the measurements on these groups cannot, however, be used as criteria of all groups of persons showing these impairments, because the recruits here reported on had been passed by local draft boards and were therefore highly selected, probably representing the best of that impairment class.

This volume is an excellent handbook. The data are clearly presented and carefully analyzed. For every measurement taken there are tables giving the comparisons between groups from individual states and sections of the country, and between recruits of various nationalities. Charts and graphs bring out clearly the points of interest. For the student who wishes to study in even greater detail the data presented, there are tables of correlation between many pairs of measurements. A definite and valuable contribution has been made to the anthropologic data on young American men.

Margaret E. Gantt

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*Monetary Policy, Being the Report of a Sub-Committee on Currency and the Gold Standard,* by J. H. Clapham, C. W. Guilleband, F. Lavington, D. H. Robertson. London: P. S. King & Son. 1921. 75 pp.

The currency disorder now prevailing in what was formerly the "gold standard world" has opened another era of discussion concerning monetary problems. In Great Britain, where the currency has not depreciated beyond the hope of redemption, the discussion has already led to the collection of information and the consideration of alternative policies. This pamphlet, the report of a sub-committee appointed by the British Association for the Advancement of Science, presents the relevant statistical data for the period from 1914 to 1921, woven together by comments which indicate the significance of the changes in such matters as the volume of currency, the national debt, the balance of foreign trade, and the level of prices. On the basis of this information the report then considers two general questions: first, whether the level of prices most conducive to the general welfare would be higher or lower than the post-war level, and by how much; and, second, the desirability of a return to an effective gold standard.

In the consideration of the second question the report is most suggestive. While the restoration of the old gold standard is not viewed as the final goal of monetary policy, yet it is regarded "as a respectable interim measure the accomplishment of which would be worth some trouble and inconvenience." The possibility of reëstablishing specie redemption in England seems to depend upon the relative movements of the price levels in the United States and in England. The passing of the present business depression, it is held, will furnish an opportunity for pursuing a policy which might bring English prices nearer to the gold price-level. With the return of prosperity and the increase of prices which may be expected to accompany it, the policy recommended is the restriction of the rise in English prices by moderating the expansion of bank currency. If, during the same period, the United States made full use of the available bank credit, the gold price-level would rapidly advance, and "the gap between the American and the English price-levels would, for the time being, be at least partially closed." The adoption of such policy, it is recognized, would require of borrowers in England, both private and public, an unaccustomed restraint in the use of bank credit; and, further, the success of the policy would depend largely upon the rediscount policies of the Federal Reserve Banks. The conclusion is, apparently, that if the United States will indulge sufficiently in a differential inflation, then England may be able to resume specie payments.

The argument in favor of restraining the boom and controlling the expansion of credit as a means of restoring the gold standard is put very briefly. The member of the committee who wrote this portion of the report, Mr. Robertson, is to deal more fully with the proposal in a forthcoming book.

W. W. STEWART

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*Forty-fifth Annual Report of Criminal Statistics of Canada, for the Year Ended September 30, 1920.* Ottawa: F. A. Acland. 1921. xviii, 326 pp.

An inhabitant of the United States has only to read this report to be thoroughly ashamed of the backward position of his own country in the collection of criminal statistics. This report, printed in both French and English, contains the kind of information that ought to be readily available for the student and the statesman concerning crimes and criminals in the United States. When one pauses to consider the fact that the United States publishes no judicial criminal statistics and has not published any prison criminal statistics of more recent date than 1910, one can but marvel that Canada is now publishing its forty-fifth annual report.

À propos of the present vague discussion in the United States over the so-called "crime wave," it is refreshing to know what is actually happening in Canada. There was an increase in convictions in 1920 over those in 1919 of 25.14 per cent; but the increase is almost entirely in non-indictable offenses. The increase in indictable offenses was but 0.25 per cent, the lowest ratio of increase since 1917. Serious crimes have, therefore, received a decided check. The percentage that juvenile conviction made of the total convictions has also fallen. Prior to 1919 this percentage had been increasing steadily for a period of fourteen years.

The report throws considerable light on the efficiency of the machinery of justice. For the first time the report contains police statistics, covering eighty-eight towns and cities. From these, it appears that 183,126 offenses were known to the police and that 161,468 persons were arrested or summoned to stand trial, a proportion that is surely commendable. However, the ratio of arrests to known offenses is not so high for certain crimes that are now puzzling the police in the United States. For example, there were 5,655 burglaries, house, and shop breakings, and only 2,317 arrests; 663 highway robberies were reported, yet the courts dealt with but 332. Encouraging, however, is the fact that the police recovered 3,534 of 3,682 automobiles that were reported stolen. Turning to the work of the courts we find that the percentage of convictions for indictable offenses has been steadily increasing for a long period of years. It is now 79.8 per cent.

Interesting too is the fact that the report shows a steady increase in the use of fines and the suspended sentence, while, on the other hand, sentences to terms of imprisonment have decreased, especially those sentences of five years and over. This shift away from severity of punishment has not brought any noticeable increase in the number of habitual criminals. Indeed, the percentage of those convicted two or more times has remained nearly fixed at fifteen for the last thirty years.

Who, according to the report, are the criminals? In the first place they are mostly men, the figures showing a ratio of 10 males to 1 female for indictable offenses and of about 16 males to 1 female for non-indictable offenses. The proportion of males to females is, moreover, increasing for both classes of offenses. The criminals come from the cities. In 1911 the urban population constituted 42 per cent of the total population of Canada, but the cities and towns produced 87.7 per cent of those convicted of indictable offenses. A little over one half of those convicted of indictable offenses are native-born Canadians. Those who claimed a religious affiliation of any kind, with the exception of those of Jewish connections, were represented in the criminals convicted of indictable offenses by a smaller percentage than the members of their respective denominations were represented in the general population. Probably the Jews suffered in this comparison on account of the fact that a Jew was no doubt thought to belong to a synagogue because he was a Jew.

The report seems weak with respect to comparisons of the various groups of offenders with the corresponding groups in the general population. The country of birth is given for the offenders, but we are not told anything about the foreign-born in Canada. We learn the occupations of the convicted group, but do not know the occupational groupings of the general population. The same thing is true with regard to the educational status: we have it for the convicted but not for the country. Another defect is that too little is said of those convicted of non-indictable offenses. No doubt it is much more difficult to obtain the social facts concerning this group of offenders, but it would be well worth the additional effort. Taken as a whole the report is, nevertheless, an excellent summary, and we who are interested in the development of this branch of statistics in the United States can but regard it as the goal of our own endeavors.

LOUIS N. ROBINSON

Swarthmore, Pa.

*The Unemployment Problem.* National Industrial Conference Board, Research Report Number 43. New York: Scribners. 1922. 91 pp.

This report presents, in handy summary form, a compilation of the results of the more important inquiries so far made in this country concerning the extent, distribution, and causes of unemployment, together with a somewhat uncritical discussion of these results and of suggested remedies. The presentation and discussion of the evidence—statistical, for the most part—as to the extent and causes of unemployment occupy about two thirds of the report, the remainder being devoted to a short preliminary discussion of the meaning and significance of unemployment, and to a brief but systematic résumé of suggested remedies.

The Conference Board has here a compilation and discussion of statistical material already published, not a report of a first-hand investigation. There are, indeed, a few pages in which the Board essays to "give an intimate view of the existing employment situation." In these few pages are set forth the replies elicited by one of the Board's circular letters and reporting in very general terms the unemployment situation—estimated number unemployed, employed part time, etc.—in different parts of the United States in the summer of 1921. For example: "In Connecticut, 120,000 persons were estimated to be idle on August 15, 1921. This represented a decline of 51 per cent in employment since July 1, 1920." This section of the report is, in the reviewer's opinion, the least valuable part of the book.

The report is valuable chiefly because it sets forth in convenient form the results of first-hand, official inquiries. The Board's chief reliance is upon the fairly well-known Massachusetts and New York reports. In addition, the more fragmentary records from Arkansas, New Hampshire, New Jersey, Ohio, and Wisconsin are drawn upon. The figures collected by the Federal Bureau of Labor Statistics, the United States Employment Service, and the Bureau of the Census are, naturally, referred to. The only unofficial investigation whose results are presented in the Board's report is the one conducted by the Metropolitan Life Insurance Company in 1915 to supplement the inquiry made the same year by the Bureau of Labor Statistics. The study made by Hornell N. Hart of "Fluctuations in Employment in Cities of the United States, 1902 to 1917" is not mentioned.

In its preliminary discussion of the problem the Board makes the usual distinction between "idleness" and "unemployment," the latter being identified as merely one phase of the former. If the reason that a person is not at work is simply that he does not want to work, he is voluntarily idle, not "unemployed"; if he is not working because he cannot find a job he is involuntarily idle, and "unemployed." Reasonable as this may seem to be as an academic classification, there are two serious practical difficulties involved in its application, neither of which the Conference Board escapes in its report. The first difficulty is that the definition is not complete until it is decided whether a person who wants to work at his regular craft, but not being able to get that particular work remains "idle" because he is unwilling to work at such other work as he may find available, possibly at a wage lower than his customary one—whether such a person is or is not "unemployed." The Board does not touch upon this dilemma and, presumably, would say that a person in the predicament just stated is idle but not unemployed. The second difficulty is probably more important, and for this reason: The existing figures on unemployment do not and probably cannot be made to show merely the number of those who are both jobless and willing to work, at something or at anything. The figures, whether they report unemployment in terms of reduced employment or directly in terms of the number without jobs, actually do include persons of every degree of work-shyness, ranging from the person who is shy in respect to any kind of work to the person who is shy in respect to none. Thus, the figures upon which the Board is obliged mainly to rely—those from Massachusetts and New York—are not unemployment figures at all as the Board has marked out that term. They are idleness figures, and, indeed, that is the term used in the original state reports.

It does not seem to the reviewer that the Board has taken sufficient care in adapting to its own purposes the statistical source material which it uses. The reader certainly is left in the dark as to just how certain statistical conclusions are reached. On page 27 there are assembled in a table estimates (of the average number of days lost per wage-earner) made in five different official investigations between 1885 and 1920. The highest average number of days lost is 63, the lowest 29; the other three investigations show figures falling between these extremes. The Conference Board, averaging the five estimates, foots up the table with 12 per cent as the "average idleness found per person employed," and 42 days as "the equivalent number of days lost per wage-earner per year." In its general summary at the end of the report the Board puts it at 42 days or 14 per cent of the "total working time" (page 86). One or the other, obviously, is incorrect. It is impossible to check up this discrepancy because the Board nowhere explains just how it deduces the number of days lost per wage-earner from the average percentage of idleness per wage-earner. In the same table the Board shows the "average idleness" reported by the United States Department of Commerce and Labor in its iron and steel investigation of 1910 to be "7 weeks or 13.5 per cent." The corresponding "equivalent days lost per wage-earner" are given in the table as 63, and referred to in the text as "about 63 working days of comparable length." The explanation, obviously, must lie in the very large amount of over-time worked in the iron and steel industry—over-time evidently equivalent, on the average, to more than two full weeks of over-time distributed over each 7-weeks period of straight time.

In its discussion of various causes and remedies the Board presents a balanced ration. Causes are listed as "internal" or "external," the internal causes being further subdivided into "personal" and "impersonal" factors, and external causes into those "of economic origin" and those "of political origin." Some official statistical evidence (from the same sources as indicated above, for the most part) is presented to show the proportion of unemployment, or idleness, rather, due to sickness, strikes, etc., and the proportion due to external causes of economic and political origin respectively. Figures are also given showing the proportions of separating employees who stopped voluntarily, were laid off, or were discharged. For the rest, the material consists of a somewhat brief and sketchy discussion of various causal factors. The discussion of remedies follows the same classification and, necessarily, is entirely descriptive. Some emphasis is placed upon personnel administration, improvement of employment facilities, reduction of transportation costs, encouragement of foreign trade, unemployment insurance, and public construction work. The report contains a number of interesting charts.

PAUL F. BRISSENDEN

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*Business Statistics: Their Compilation and Presentation*, by R. W. Holland O.B.E. London: Sir Isaac Pitman & Sons, Ltd. 1921. 85 pp.

Although for the most part it maintains the point of view of actual business management, this book is meager. It defines business statistics primarily as statistics obtained from the financial and cost accounts of a business. There is little recognition of the wide range of non-accounting statistical data now being obtained from both internal and external sources for practical guidance in business management. Even within the field of business statistics that have their origin in accounts, no recognition is given to the development of uniform accounting or to such statistics as those for stock-turn and credit ratios. The explanation of the advantages in basing expense percentages on sales instead of on cost is weak. The use of daily comparisons for practical administrative purposes in many businesses is unduly belittled. Over one half the book is given over to an elementary explanation of the preparation of charts. Despite several good features in the chapters on charts, the dangers of using a base-line other than zero are not adequately recognized, and in explaining the use of circular area charts it is stated that the areas of two circles are proportional to their radii! The book is hardly safe for beginners, and it will provide few new ideas for experienced statisticians.

Melvin T. Copeland

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*Report on the Food Supply of the Port of New York District.* Report of the Port of New York Authority. Albany: J. B. Lyon Co. February, 1922. 74 pp.

This report fills a long-felt want of statisticians, economists, and public marketing officials, all of whom have on various occasions found themselves handicapped because they were unable to find in any one place the information contained in this pamphlet. The Port of New York Authority has collected in this report all available information regarding the annual and seasonal receipts of the most important commodities making up the food supply of the New York District.

For the purpose of ready reference a table on page 11 gives the calculated net receipts of those commodities which represent probably more than 90 per cent of the food consumed in the Port District annually. The extensiveness of this report may be indicated by listing the main groups of commodities for which general data as to receipts and sources of supplies are given in Section II. The groups are covered in the following order: milk and dairy products, flour and grains, meat and meat provisions, vegetables, fruits, fish, sugar, coffee, tea, dried fruits, dried beans and peas, nuts, vegetable oils and compounds, and lard.

A snapshot of the storage of foods within the Port District is presented in Section IV, which brings out the striking fact that the New York and New Jersey state authorities do not receive uniform reports on foods in cold storage. In fact, the statistics showing the New Jersey holdings were so meager that no total for cold storage holdings in the Port of New York District could be given. The New York State Department of Farms and Markets was able to give details on the various kinds of meats and poultry, whereas the New Jersey authorities merely classified meats and poultry broadly. The table on cold storage holdings clearly shows the need for a better coördination of records of supplies of foodstuffs on hand.

On looking into the holdings of food in dry storage warehouses, the Port Authority found that no agency, either public or private, kept records of these holdings. In fact, no public agency at the time this survey was started had even an up-to-date list of dry storage food-warehouses.

The statistician and the student of food-marketing problems will find it most profitable to devote their time and attention to a study of Appendix A, where they will find data on which the statements in Section II were based. Table I in Appendix A (page 41) shows a somewhat different attitude in the analysis of the same commodities represented on page 11. In one place butter and cheese are grouped with milk under "Milk and Dairy Products;" in another, butter and cheese stand alone. In the table on page 11, live poultry and dressed poultry are placed under "Eggs and Poultry," and in Table I of the Appendix, live poultry and dressed poultry are placed under "Meats." Then, very strangely, after having made entirely new groupings in Table I, all of the remaining tables in the Appendix follow the order of the table on page 11.

The first table in the Appendix shows the "receipts," "deductions for outbound shipments, exports, and storage," and "calculated net receipts." Apart from being made to conform with the arrangements of the table in Section II, this table could have been improved had the exact amount of each deduction been shown in separate columns instead of having been lumped in one column. There should have been columns for exports, outbound domestic shipments, and net in or out of storage movements. Wherever possible, the domestic receipts should have been given separately from the foreign imports.

The tables in the remainder of Appendix A give the receipts of most commodities by months. Receipts of fruits, vegetables, butter, cheese and eggs are further classified by the states from which they are received.

Although the report mentions the names of the organizations from which the receipts of the various commodities were compiled, it is to be regretted that the footnotes to the tables as to sources are not more numerous. Some of the data in the Appendix were checked by the reviewer with statistics that he compiled independently for use by his classes in economics. In most cases it was found that the two sets of figures correspond closely. The reviewer, however, differs with the dressed poultry figures. Reference to the general statement of sources shows that whereas the live poultry figures were secured from the Urner-Barry Co., the dressed poultry figures were secured from the United States Bureau of Markets. A careful study of these receipts and a comparison of the Urner-Barry and the government figures over several years have convinced the reviewer that the Urner-Barry figures are the more accurate, and that the dressed poultry figures—stated at 101,292,133 pounds in this report—are about 25,000,000 pounds too small.

The food requirements for the Port District population were determined in another way in Appendix B and summarized in Section II. Here some six studies on food budgets were reduced to a common denominator and applied to the Port District population, which was taken to be 8,000,000 and reduced to 6,240,000 "equivalent adult males." In the determination of this latter figure, application of the Sydenstricker and King "fammain scale" (explained in the September, 1921, issue of this Journal) was made to New York City. A comparison of the selected estimate of the total annual consumption of certain foodstuffs with the calculated net foodstuffs shows close approximation.

In conclusion it may be stated that the report of the Port Authority is a distinct contribution to the literature on food distribution in the Port of New York. In addition to providing the first authoritative publication on the receipts of foods in New York, the report shows the need of a more effective method of gathering and assembling current food information in a readily available form. The present study is in part accidental in that its original purpose was to form a basis for meeting the situation growing out of the threatened railroad strike last October. The collection of these data was the work of a committee of the various governmental agencies concerned with food distribution within the Port District, of which Herschel H. Jones was chairman. As the Port Authority is not likely to publish under normal conditions similar reports in the future, the trade and the public food-marketing bodies should work out a plan for joint future activities in this direction.

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# THE NET VOLUME OF SAVING IN THE UNITED STATES

## MEASURED BY THE INCREASE IN THE TOTAL WEALTH OF THE COUNTRY[1]

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## PART I

### A. INTRODUCTION

From time to time, various economists and financial writers have presented estimates of the extent of saving in the United States. In most of these cases the term "saving" has not been carefully defined. If the word had only one commonly accepted meaning, this omission might be a matter of but slight moment; but, as a matter of fact, the term is used in a number of different senses which are but slightly related to one another. In most instances, however, the statement of the purposes of the investigation enables a reader who is himself familiar with the various usages of the word to select the particular definition of saving which is applicable. A perusal of their writings will show that some investigators have sought to ascertain the relative thriftiness of different classes of the population. Others have been interested in the actual or potential supply of loanable funds. Some have sought to ascertain the adequacy of the provisions made to meet periods of adversity. Still others have desired to measure the increase in the wealth of the nation.

It is to be feared that some writers on the subject have not only failed to define the term "saving" in a formal way but have sometimes included in their aggregate of "savings" items that do not logically belong in the category under discussion. In order to avoid falling into a similar pitfall it seems highly desirable, in undertaking a new study, to discuss the various types of saving and to set rather precise limits to the field which is to be covered. Such a procedure is attempted in the pages which immediately follow.

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## B. THE MEANING OF THE TERM "NET SAVINGS"

Accumulation Versus Retention of Assets.—Saving may be thought of either as the accumulation or the retention of assets. Thus we say that by careful economy a man has saved a competence from his earnings, meaning of course that he has accumulated wealth little by little; but we also say that one man has saved his inheritance while another has squandered what was left to him by his parents. In this latter usage there is evidently involved no thought of accumulation but only the idea of successful retention of assets. This use of the term "saving" as synonymous with the retention of wealth has been emphasized by many economists in connection with the effect of waiting and abstinence upon the interest rate. When, however, one speaks of the volume of saving in a country, the reference is invariably to the accumulation and not to the retention of assets, and it is the rate of this accumulation which statisticians frequently attempt to measure. The discussion which follows will deal exclusively with saving defined as a process of accumulation.

Does Saving Connote Effort or Sacrifice?—Popular usage often associates the term "saving" with effort and sacrifice. Thus it is felt that the workman who toils arduously and uses only a small fraction of his earnings for the purchase of consumption goods is necessarily a great saver. If, however, he invests these earnings in "wild cat" securities or loses them at the gambling table, he is nothing ahead at the close of the year. If his procedure constitutes saving, it is certainly not of the type that can be dealt with successfully by the accountant or the statistician; they find it most practical to define net saving as an increase in net assets[1] between any two given dates.

Net Saving Defined.—From this point of view, *net savings are additions to the stock of consumption goods or increases in the power to produce or acquire income which have arisen through the acquisition of property or through investments in education.*[2] This definition is the one which accords with the purposes of this investigation.

Saving May Be Fortuitous.—According to this definition, saving may involve no effort on the part of the saver, for net assets often increase through purely fortuitous circumstances. Since, however, such gains might readily be used for the purchase of consumption goods, there seems no reason for excluding from the category of savings such gains as may be retained to the end of the period under consideration.

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[1] "Net assets" in accounting parlance means the total value of property owned less total indebtedness.

[2] It is impracticable to measure statistically gains in the form of investments in education.

The Nature of the Objects Saved.—Any complete analysis of saving must deal not only with the process but also with the nature of the objects saved. Saving presumably began with the accumulation of stores of consumption goods. Early in the history of the human race, however, saving began to take the form of improvement in the equipment used in getting a living. Today we convert our efforts into railways, buildings, machines, tools, and other devices which enable us to utilize more easily the resources and forces furnished us by nature. Some of the most expensive and important forms of saving are not tangible but consist of such things as accumulated scientific knowledge and the training of the human mind. Savings of the last-mentioned variety are extremely perishable, since they are constantly being lost through the death of the persons possessing the education. Accumulated scientific knowledge is, on the other hand, the most durable form of savings. Although it is true that new discoveries and the introduction of new processes do frequently diminish or nullify the value of certain kinds of knowledge, it nevertheless seems highly probable that the proportionate loss in this field is far less than that which occurs in the case of buildings, machines, and the like.

## C. AN ANALYSIS OF THE PROBLEM OF MEASURING THE SAVINGS OF THE NATION

The Savings of the People of the Nation.—Saving may be considered not only in connection with the nature of the objects saved but also as regards the persons or groups who save or who are the beneficiaries of the saving. Thus, we may, for instance, study saving from the national point of view. A nation's savings during any period evidently are comprised of increases in:

(1) The stock of wealth in the form of material goods used either for production or for consumption by the government or by the inhabitants. This evidently includes improvements in the land itself as well as additions to the stock of buildings and of movable goods.
(2) Valuable claims[1] against other nations or their inhabitants.
(3) The accumulated store of scientific knowledge.
(4) The productive power of the individual inhabitants resulting from education, hygienic measures, etc.

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[1] These claims are evidences of equities in a stock of tangible goods located abroad which either have been produced or are expected to be produced.

The Effect on National Saving of the Diminution in Free Goods and in Natural Resources.—The fact should not be overlooked that the net increase in the stock of material wealth (free goods plus economic goods) is likely to be distinctly less in amount than the increase in the stock of economic goods; for while the quantity of machines, buildings, and similar improvements has been rapidly increasing in most civilized countries, there has been at the same time a decided diminution in the aggregate of the undeveloped resources of the nation. In the United States, for example, there no longer exist the once great areas of fertile land awaiting the plow or the vast forests of virgin timber which formerly covered much of the country, and our mineral resources likewise have been largely exploited.

It is necessary to remember also that in the realm of economic goods the loss of soil fertility and the depletion of our mines goes far to offset the increase taking place in the quantities of goods produced by the aid of man's efforts. Allowance for such deterioration is always necessary before any accurate picture of national saving can be obtained.

It is, however, doubtless true that the loss in natural resources has been offset to no inconsiderable degree by the bringing into use of new land which, under the conditions prevailing at an earlier period, had little or no utility to mankind. Furthermore, science has given great utility to national resources which were formerly wholly useless. That this factor is not of negligible importance is made evident when we remember that two centuries ago anthracite coal was believed to be fit only for ballast, that no means had been invented for utilizing more than an infinitesimal fraction of the available water power, and that rubber was deemed useful merely for pencil erasers. These are only a few of the many similar examples which might be cited.

Although the changes which have occurred in the inventory of natural resources are very real they are also extremely difficult to measure with any reasonable degree of accuracy, and the problem of calculating the national savings is greatly complicated by this fact.

Saving by Governments.—National saving differs radically from governmental saving. The latter is usually referred to as public saving. Governments accumulate:

(1) Public buildings, parks, canals, roads, vessels, machinery, etc.
(2) Money or credits—in other words, valuable claims against private persons or other governments.
(3) Improvements in the administrative system and organization.

Private Saving.—Private saving is much more akin to governmental than to national saving. Private saving is carried on both by individuals and by business units. At the present time the larger business units are principally organized in the corporate form, while the smaller businesses are conducted mainly by individuals. In the latter case it is often impossible to distinguish the savings of the business from the personal savings of its owner. Private savings consist of:

(1) Increases in stocks of consumers' goods (direct goods).
(2) Improvements in business equipment.
(3) Improvements in business organization.
(4) Increases in holdings of money and credits—that is, in holdings of valuable claims against governments or other business enterprises or persons.
(5) Acquisitions of stock or part ownership in other business enterprises.
(6) Improvements in acquisitive power due to educational or hygienic measures.

Money and credits (the fourth in the list of private savings) are often given especial prominence by writers on the subject of saving because this form of savings is commonly used for one of two purposes, both of which are of great importance in their effect upon business activity. Money and credits are commonly either exchanged for other goods (thus affecting market prices), or are loaned to entrepreneurs in order that they in turn may either obtain commodities needed in their business or gain control of other enterprises (thus affecting interest rates).

Savings Affected by Changes in the Price Level.—In the computation of savings in terms of money value, it is of course imperative to eliminate at the start all changes in values resulting from variations in the price level. The price indexes obtainable may themselves be so erroneous that this single necessary correction will in itself be sufficient to prevent estimates of most classes of savings from attaining any high degree of accuracy. This, however, is only one of several obstacles tending to hinder the statistician who undertakes inquiries in this field.

The Volume of Private Saving is Not Necessarily Gaged by the Value of New Securities Floated.—The assumption is frequently made that the extent of saving in a country can be measured by the volume of funds offered for investment in notes, bonds, mortgages, or similar securities. It is true that a large part of such loanable funds consists of amounts set aside from current income for investment purposes. However, it is also true that when business men are optimistic concerning the business outlook they desire to invest most of their free funds in entrepreneurial undertakings, but when they become pessimistic they curtail the extent of their operations and become desirous of loaning not only part of their current income but also money accumulated through reduction of inventories.

It is true, however, as is shown in Part II of this article, that in years when business profits are large the sales of bonds likewise are generally above normal. This increase in bond sales presumably represents principally a rise in the curve representing the demand for loans rather than an increase in the supply of loanable funds offered at a given interest rate, for it is a well-known fact that in boom times interest rates rise sharply. It appears, therefore, that the supply of loanable funds offered at any given interest rate may be a poor criterion of the extent of private saving in the country. This lack of direct relationship, however, does not preclude the fact that variations in the actual sales of bonds may be a rather good gage of changes in the volume of private saving in general. But, even though bond sales measure roughly fluctuations in the volume of private saving, it is evident that since private savings may represent no accessions to the national wealth, bond sales are not necessarily good criteria of the accumulations made by the nation as a whole.

Some Types of Saving Not Measurable.—It is extremely difficult if not entirely impracticable to measure statistically savings embodied in human beings. The statistical part of this study will therefore be confined wholly to those savings external to the people themselves. But, owing to the paucity of available data, it is far from possible to measure all the types of external saving concerning which there may be a widespread interest. Although it is, for example, as stated above, perfectly feasible to ascertain the approximate amounts invested each year in certain types of securities, it seems entirely impracticable to estimate another related quantity, namely, the potential supply of loanable funds. In attempting the computation of this quantity, certain students seem to have made the assumption that the aggregate volume of private saving in the nation is a more or less immutable quantity which cannot be changed materially but which can only be shifted from one field to another. There seems to be little ground for accepting the validity of this hypothesis. As a matter of fact, the extent of private saving seems to vary greatly with different phases of the business cycle, and it appears highly probable that in time of great national emergency the people of the United States might save treble the average amount laid aside in normal times. In fact, the only limit upon possible saving is that enough of the net personal income remain for consumption to supply the population with the barest necessities, and this minimum would doubtless require considerably less than half the total income of a prosperous nation like the United States. The measurement of the potential supply of loanable funds evidently involves the determination of a supply curve at each date; for manifestly the supply offered would vary according to the rate of interest. Since there is every reason to believe that there are wide variations in the conditions affecting both the demand for and the supply of loanable funds, it appears to be extremely difficult if not impossible to derive for this field either supply or demand curves which can lay any claim to even approximate accuracy.

Net Private Saving Very Different from Gross Private Saving.—In dealing with the question of savings, it is well to remember that one can gain no adequate idea of the volume of national saving by adding together gross private savings of various kinds, the reason being that these gross private savings are so largely offset by losses, wastes, and expenditures for consumption goods, and that the net amounts remaining are often relatively trivial. For example, very many millions of dollars of savings are invested each year in enterprises which fail, and these savings are thereby dissipated. Billions were saved by the American people and invested in Liberty Bonds, but the proceeds were used to purchase war supplies, and hence the country is now little if any richer because of the saving. The savings of the working classes are largely utilized to cover the expenses of vacation outings, weddings, and funerals. Such uses evidently lead to no increase in the nation's wealth. It follows that the volume of gross private saving does not necessarily bear any fixed ratio to the volume of net private saving remaining after all deductions have been made; hence the former cannot be regarded as an accurate criterion by which to measure the latter.

If, however, it were possible to ascertain for any given interval of time the net savings of the various individuals in the country, and if these net amounts were summated and their aggregate added to the net savings of all governmental units during the same period, the total would represent the quantity most sought in this study, namely, the net national saving for the period.

Measurable Types of Saving.—Owing to the numerous difficulties involved in the statistical measurement of savings it is the part of wisdom for the statistician to confine his efforts to measuring those few types of saving for which fairly satisfactory data are available. Even in these few cases the margin of error is likely to be large. However, it is probably true that mere approximations may prove to be of considerable value. In some instances in which absolute measurements are impracticable, it is still perfectly possible to obtain figures which show the relative fluctuations in the volume of accumulation, and these figures throw light on certain economic problems.

The following outline shows the relationship to each other of some of the numerous types of saving in the United States. These types have been selected because they seem to be both susceptible of rough statistical measurement and also of sufficient general interest to warrant an effort to compute their volume.

I. First, classification of the annual increase in the entire wealth of the nation.
  A. The increase in the net value of claims against foreign nations.
    1. Private claims.
    2. Claims of the United States Government.
  B. The annual increase in the internal wealth of the United States.
II. Second classification of the annual increase in the entire wealth of the nation.
  A. The increase in the value of claims of the federal government against foreign nations.
  B. The increase in the value of the other assets of governmental units. (These assets can be estimated only in a very rough way.)
  C. The volume of business savings. (This estimate must be based mainly upon the reports of savings by corporations.)
  D. The net amounts saved by the people from their personal incomes. (This quantity can be calculated only roughly by subtracting estimated business savings from the estimates of total private savings.)

It is therefore to the measurement of these selected items that the statistical studies which follow are directed.

The Use of Money Values in the Measurement of Savings is Unavoidable.—In the calculation of the amount of saving we are primarily interested in the increase in the utility of the stock of goods on hand and not in the increase in their money value. The direct measurement of the total utility of the nation's stock of goods is, however, practically impossible. We are driven, therefore, to the indirect method of using money value as an intermediary through which we must pass in order to arrive at a measure intended to indicate for different years the relative income commanding power of the stock of wealth on hand. As a first step in this direction it appears necessary to estimate the current valuations placed each year upon the internal wealth of the nation.

If values are to be used in a measurement of wealth which in turn is to be taken as a basis for computing savings, the question arises as to whether we shall base our estimates upon the values of property rights represented, for example, by stocks, bonds, and paper money, or whether we shall confine ourselves to a study of the values of physical wealth only. The former method is more direct and is at least as accurate in principle as the latter. The practical reason for confining our studies to valuations of physical wealth is that while the census reports profess to cover this form completely they furnish us but little information concerning the value of property rights. Since the census gives us our only broad base, we have, then, little choice as to the procedure to be followed. As a matter of fact, it seems reasonable to suppose that the net value of all property rights is approximately equal to the net value of the physical wealth upon which those property rights are based.

We must not lose sight of the fact, however, that when wealth is expressed in terms of value, the value is a measure of property rights and not of a quantity of physical objects or of an amount of utility.

In Measuring Savings all Property Values must be Treated Alike.—Since we have defined national saving as being equivalent to the sum of private and governmental saving, and since either of these kinds of saving is measured by the increase in net worth between two dates, there is evidently no distinction whatever to be made between the values of different types of property. It is, therefore, wholly immaterial whether the property value is based upon land or other national resources, upon buildings or equipment, or upon consumption goods. In any case, if the price level has not changed, every gain in net worth is to be counted as saving.

The General Plan of Attacking the Problem.—In order to measure the total savings of the people of the nation, the most feasible procedure seems to be to take the following successive steps:

1. Measure the total wealth as expressed in dollars of the current year.
2. Find what the wealth in each year would have been worth if the price level had remained the same as in 1913.
3. Ascertain the increase during the entire period in this wealth measured in unchanging dollars.
4. Apportion this increase as accurately as possible between the different years of the period.

In order to understand the nature of changes in wealth it seems necessary first to analyze rather carefully the principles which determine the valuation of indirect goods.

## D. THE PRINCIPLES OF VALUATION AND THEIR RELATIONSHIP TO THE VALUE OF WEALTH AS REPORTED BY THE CENSUS BUREAU

How Indirect Goods Are Valued.—A large part of the economic wealth of the people of the United States consists of real estate, transportation systems, and machinery—all typical examples of durable indirect or production goods. Such goods derive their value wholly from the anticipated values of the future services which they are expected to render or of the products to which it is anticipated they will give rise. Each owner or prospective purchaser who is interested in these goods from the standpoint of income discounts the values of these various future products or services at his own subjective interest rate and adds the resulting amounts together to arrive at a total which represents the present subjective value of the goods in question to the given individual. A dealer or speculator, however, may have no direct interest in the services which the goods are expected to render, for, if an owner, he hopes to sell the goods soon; if a prospective purchaser, he intends to buy merely in the hope of making an early sale at a quick profit. His subjective price, therefore, represents not discounted income payments but merely his anticipated selling price discounted to the present date at his subjective interest rate. In times of active speculation both buyers and sellers sometimes almost entirely lose sight of the income expected from the goods; but such a condition of affairs is usually quite transitory. Prices based upon the present worth of anticipated services are the forces which in the long run are dominant.

The subjective prices of all interested persons whether speculators, dealers, or investors, impinge upon each other in the market, and in this way a price is determined at which exchanges of some units actually occur. This market price is then commonly imputed by the statistician to all units existing under like conditions. Statisticians add together the estimated values thus arrived at to obtain estimates of the total value of a given kind of wealth.

Value of National Wealth Fluctuates with Every Change in Public Opinion.—The above analysis indicates that the value of wealth in a country at any given date is fundamentally dependent upon the subjective valuations placed upon the various items by persons owning or dealing therein. Anything that changes these subjective valuations must then necessarily affect the total value of the wealth of the country. Each person in fixing his subjective value for any article is influenced primarily by two factors: first, his belief as to the value of the service or product at the date at which he expects it to be disposed of; second, his present subjective rate of discount for future values.

It follows, therefore, that whenever most of the interested parties change their opinions as to the future selling price of the products, the present value of indirect goods at once changes. This is easily illustrated by the value of a share of stock. If it is the current opinion that the stock in the future is likely to earn on the average 5 per cent per annum, the stock may sell for $40 per share; but if for any reason whatever—perhaps only because of an entirely baseless rumor—most of the persons owning or desiring to purchase the stock are suddenly convinced that it will probably earn, for an indefinite period, an average of 10 per cent, the value of the stock will quickly increase to the neighborhood of $80 per share. Similarly a change in opinion as to the prospective level of railway rates will affect the value of railway systems, and an increase in optimism on the part of steel manufacturers will enhance the value of steel works.

A change in opinion concerning interest rates is no less important in affecting subjective and market values than is a change in beliefs concerning prospective selling values. When a man who has been estimating that money is worth 4 per cent to him suddenly decides that it is instead worth 6 per cent, the present worth to him of every item of future income, and hence of durable goods in general, evidently drops off sharply. If others generally change their views in the same way, the resulting fall in subjective values tends quickly to lower market values.

From what has just been said, it follows that the value of the economic wealth of the country really fluctuates up and down, not in proportion to changes in the average prices of consumption goods, but rather in consonance with waves of feeling regarding interest rates or pertaining to anticipated future prices.

Statistics of Wealth Values Commonly Represent Trends rather than Current Values.—Such oscillations, however, are likely to be smoothed out to a considerable extent in statistical reports of aggregate wealth, for these reports are often based upon inventory valuations as carried upon the books of business concerns, and these "book values" are commonly more closely connected with costs or with records of financial transactions than with actual present values. This point must be kept in mind in dealing with statistics of wealth as commonly presented. The United States Census of Wealth should, for this reason, be regarded as recording rather an approximation to the trend of total values than the actual sum of the market values at a given date.

Saving is Better Measured by the Trend than by a Record of Actual Values.—In measuring the savings accruing during a given period, it evidently is necessary to adjust the inventories at the beginning and at the end of the period to allow for changes in the purchasing power of money. It appears also from the preceding line of reasoning that, if possible, adjustments should be made to counteract variations in values due to shifts in the public psychology in the direction of optimism or pessimism; for it seems rather absurd to say that the nation has suddenly saved fifty billions of dollars because the interest rate has fallen or because a wave of optimism has just swept over the country. Yet such causes might easily produce such a change of values in the course of a few months. In practice, however, it is most difficult to make corrections to offset price level changes. Presumably, one of the best methods of eliminating those changes in the value of property arising merely from transitory changes in public opinion is to read the desired values at the various required dates rather from a smooth trend than from the actual values prevailing at the various dates. Since, in practice, the data are commonly too inaccurate to permit of more than a rough approximation to the truth, it is unnecessary to devote much energy to refining the methods of treatment. It is nevertheless desirable that the ideal sought should be visualized as clearly as possible.

The Census Bureau's Estimate of the Value of the Wealth of the United States.—Having considered the principles determining the valuation of durable goods, let us now see how these principles affect estimates of wealth such as have been made from time to time by the United States Census Bureau. A large part of the wealth of the United States consists of lands, buildings, factories, furniture, automobiles, clothing, and other articles which change hands only occasionally. This condition is especially characteristic of publicly owned real estate, such as canals, parks, and public buildings. Rarely, indeed, are land, buildings, and factories standardized commodities. An article included in any of the types mentioned above may either have deteriorated greatly or may have been greatly improved since the date of its last transfer. The price level may also have shifted much during the interval. Interest rates may have changed greatly. Under these circumstances, it is altogether probable that subjective values will, as a rule, have either risen or fallen materially, and, if so, the price at which the goods would sell if placed on the present market might differ radically from that paid for it when it was last sold. The present owner can, at best, measure accurately only the change in his own subjective value and can merely guess at the price which the article would bring if placed on the market; and yet his guess is likely to be better than that of most other persons. An actual enumeration of the valuations representing the unbiased opinions of the owners of property would be subject to some error, though it might be that the principle of compensation would so operate as to make the error of the total small.

The Census authorities have, however, not thus far attempted any such enumeration. In the case of the most important class of property, real estate, they have depended mainly upon valuations placed thereupon by tax assessors, and these of course are likely to vary widely from the truth. Since, in most localities, assessed values are lower than market values, it has been incumbent upon the Census authorities to multiply the total assessed value in each locality by a factor which it is supposed will give the true market value as a product. The ascertainment of the correct multiplying factor is obviously no simple task. When we consider the weaknesses of this method, it is no reflection upon the efficiency of the Census Bureau to say that its valuations of the real estate of the country represent only approximations to the facts. Yet there seems reason to believe that the Census Bureau's valuations of real estate are more accurate than are those made for some other classes of property. It appears, therefore, that the census totals must be regarded merely as rough approximations to the value of the physical wealth of the country. Nevertheless, since they are the only figures available, it is necessary to use these estimates as the basing points for any study of wealth in the United States.

## E. AN ESTIMATE OF THE CURRENT VALUATIONS PLACED UPON THE WEALTH OF THE UNITED STATES FOR THE YEARS 1909 TO 1919

The last estimate by the Census Bureau of the wealth of the country was made for the early part of 1912. For our purposes it is desirable to obtain a figure representing the value of the physical wealth of the country at the beginning of each year since 1909. The method followed in estimating the valuations placed each year upon the total internal wealth of the nation has been to assume the 1912 census figures for each category to be correct and to vary the figures for each kind of wealth in the other years since 1909 in proportion to the changes in an index number believed to represent the variations in the current value of that particular type of property. One advantage of this method is that the errors in the estimates of the different types of wealth are likely to compensate each other to some extent, thus reducing the error of the aggregate of all kinds of wealth. Fortunately, also, the nature of the available data makes this method of attack more feasible and convenient than any other. This mode of procedure necessitates the computation for each of the census categories of a corresponding appropriate index, the fluctuations of which are then assumed to be proportional to these categories in the value of that form of wealth. The manner of deriving the indexes for the respective fields is briefly indicated in the paragraphs that follow.

Real Estate.—Real estate has, for purposes of this study, been divided into three categories, namely, urban real estate, farm lands, and farm buildings. The method used in estimating the value of farm lands involves the assumption that farm acreage increased at a constant rate between 1910 and 1920. The total value for each year is computed by multiplying the acreage calculated according to this premise by the average land value in that year. This average land value has been estimated by combining the reports of the Census and the estimates of the Department of Agriculture, as recorded in the *Monthly Crop Reporter*.

The assumption followed in calculating the value of farm buildings is that these buildings have increased steadily in physical quantity and that the value of each building has varied from year to year in proportion to the rent index prepared by the United States Bureau of Labor Statistics. By use of a composite index based upon these two assumptions, values have been interpolated for the intercensal years—that is, between the 1910 and the 1920 census estimates.

The total value of agricultural real estate in 1912 has been estimated in the manner just described, and this total has been subtracted from the total value of real estate as reported by the Census Bureau. Although the remainder represents mainly urban real estate, an appreciable fraction thereof consists of mining[1] and other property situated in rural regions. However, these amounts are scarcely large enough to vitiate seriously the results obtained by using as an index the value of urban real estate as shown by the city tax departments for the various years of the decade.

The reports of the Census Bureau entitled *Financial Statistics of Cities* purport to show the assessed value of real estate and the ratio of the assessed value to the true value in each city of considerable size for more than half of the years of the decade. The supposed true value of the real estate in each city has been computed therefrom by division. The usefulness of these figures as criteria of realty values is distinctly lessened by the fact that apparently little care has been taken by the Census authorities to enter the assessment reports under the year to which they actually apply. Fortunately, direct city reports are available for the larger cities (which virtually dominate the totals), and data from these have been largely substituted for the amounts appearing in the *Financial Statistics of Cities* as basic materials for our index. In the case of the smaller cities it has been necessary to utilize the census figures as they stand. Any error arising from this source is not likely to be important for the reason that the course of the total

[1] Walter R. Ingalls, in Chapter IV of his *Wealth and Income of the American People*, estimates the value of the mines in 1916 as $3,880,000,000. This would represent about 5 per cent of all non-agricultural real estate.

of city realty values has been steadily upward throughout the period, and, with a slope so nearly constant, a slight shifting of the curve from left to right is not a matter of great moment, as it will have a negligible effect on the final results. The estimated value of urban real estate in 1912, multiplied by the indexes for the various years, gives the estimated total value of urban realty for each year of the decade.

Live Stock and Farm Implements and Machinery.—The 1912 census valuations for the above named types of farm property have been assumed to vary respectively in proportion to the estimates of the values of the same items made by the National Bureau of Economic Research in connection with its studies of agricultural income in the United States.

Gold and Silver Coin and Bullion.—The value of the stock of precious metals recorded by the Census Bureau for 1912 has been assumed to vary in proportion to the estimates of the stock of gold and silver money in the United States as shown in the reports of the Comptroller of the Currency.

Manufacturing Machinery, Tools, etc.—No adequate criterion of the changes in the amount of this category of wealth seems to be available. Under the circumstances it has been assumed to vary in proportion to the reported capital of manufacturing concerns. The possible error of this method is further increased by the fact that estimates for capital are available only for the census years 1909, 1914, and 1919, and therefore amounts for intervening years must be obtained by interpolation. In this case a smoothed curve has been used as the medium for accomplishing this end. The quantities arrived at, therefore, although probably far from accurate, may nevertheless serve to indicate the general trend in the amount of this type of wealth.

Railroads and Their Equipment.—The first impulse would lead one to turn to the physical valuation of railways by the Interstate Commerce Commission as a guide to their total value. A little reflection, however, shows that this physical valuation is intended only to measure some form of cost, and may show nothing about present value which depends entirely upon estimates of future earning power. It may well happen that owing to rate regulation, for example, the market value of the railways may have declined although both the investment in railway enterprises and the physical quantity of every kind of railway property may have increased during the same period. Such a contingency leads one to inquire whether the use of the total market value of railway securities may not give rise to serious errors in the aggregate estimate of wealth. A little consideration, however, leads one to see that the specified state of affairs furnishes no ground for suspicion; for while the reduction of railway rates forces down the value of railway property, it enhances to an equal extent the value of the property of the shippers. The correctness of the total of all wealth is then in no way vitiated.

The most logical measure of the value of the railways of the United States seems, then, to be the total value of their outstanding securities. Fortunately, the Interstate Commerce Commission reports for each year the par value of railway bonds outstanding and also the face value of stocks paying dividends and of those not paying dividends. The value of the latter class has been assumed to be one fourth as much per share as the value of the first class, and the two classes of stocks have been combined on this basis. The total for each year has been multiplied by the index of railway stock prices published by the Harvard Committee on Economic Research. Similarly the total face value of railway bonds outstanding for each year has been divided by the average yield on such bonds [1] to attain an index of bond values. The stock and bond indexes have, after appropriate weighting, been combined, and the combined index has been used as a criterion by which to measure changes in the total value of the railways of the United States in each year. While this index is doubtless not highly exact, it does not seem probable that it is seriously erroneous in any year.

Public Service Enterprises.—The ideal method of measuring the variations in the value of such concerns would be to follow the procedure just outlined in the case of railways. However, no summary of the capital and bond issues of such enterprises has been discovered. Under the circumstances, the very doubtful assumption has been made that the values of these properties have varied in proportion to the respective total income returns for the preceding years on all property invested in this field. The relative stability of corporate income in this field prevents the conclusions reached from being as erroneous as would be the case in most other lines of industry were this method applied thereto.

Agricultural Products.—It has been assumed that the value of agricultural products on hand January first has varied in proportion to the total value of such commodities produced in the preceding year. The validity of this assumption is of course lessened by the fact that the amount of crops and live stock held over and the rapidity of export vary from year to year. On the whole, however, it appears that this criterion is sufficiently accurate for most purposes.

Manufactured Products.—The stock of manufactured goods on hand at the first of the year has likewise been assumed to vary in proportion to the gross output of the factories during the preceding year. Presumably the net output for the last half of the year would be the ideal criterion, but figures therefor are not available.

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[1] Also reported by the Harvard Committee on Economic Research.

Imported Merchandise.—It seems that the value of the stock of imported merchandise on hand January first ought to be about proportional to the volume of imports for the fiscal year ending the succeeding June thirtieth. The estimates here stated have been computed according to that premise.

Mining Products.—The total value of mineral production for the preceding year, as recorded by the United States Geological Survey, is apparently the best available gage of the probable stock of mining products on hand at the first of the next calendar year. The estimates here presented have been made according to this assumption.

Automobiles.—In the study of the automobile repair industry,[1] an estimate was made of the total cost of replacing with new cars of the same type all cars in use at the first of each year. Of course they are, as a rule, not new but partly worn out. It has been assumed that their present value is 60 per cent of their value were they new. This item has therefore been added directly to the estimate of the value of the other kinds of wealth in the nation.

Clothing, Personal Ornaments, Furniture, Carriages, etc.—Since no satisfactory variable representing this group has been discovered, the assumption has been made that the value of the entire stock of consumption goods other than automobiles varies in proportion to the total value of all other physical wealth in the country.

The Current Valuation Placed on all Physical Wealth in the Nation. —The aggregate of the current valuations of the physical wealth in the United States has been computed by the simple process of adding together for each year the items above listed. To the quantity thus obtained, it is evidently necessary to add the net amount of American holdings and credits abroad in order to arrive at the total value placed upon the property of the United States and its people.

Net Holdings in and Claims against Foreign Countries.—In view of the relatively slight importance of this item, the very rough nature of the estimates of the values placed upon other types of wealth, and the existence of a very good study along this line made by Professor John H. Williams and Mr. Frank Vanderlip, it has not seemed worth while to make an independent investigation of the extent to which this country and its citizens are indebted to or have claims against foreign people or nations. The study just referred to is published in the *Harvard Review of Economic Statistics*. While the data are not presented

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[1] Made in connection with the estimate of income in the United States.

## TABLE I

### THE ESTIMATED[1] VALUE AT THE BEGINNING OF THE YEAR OF THE INTERNAL WEALTH AND FOREIGN HOLDINGS OF THE GOVERNMENT AND PEOPLE OF THE UNITED STATES, MEASURED IN PRICES CURRENT IN THE SPECIFIED YEARS

(Millions of Dollars)

| Beginning of year | Urban realty and mines | Farm realty | Live stock | Farm implements and machinery | Agricultural products | Gold and silver coin and bullion | Railroads and their equipments | Public service plants and equipments | Mining products |
|---|---|---|---|---|---|---|---|---|---|
| 1909 | $64,432 | $33,849 | $5,724 | $1,021 | $5,091 | $2,441 | $14,637 | $8,777 | $675 |
| 1910 | 66,096 | 34,801 | 6,203 | 1,111 | 5,483 | 2,455 | 15,564 | 9,331 | 799 |
| 1911 | 73,274 | 35,289 | 6,582 | 1,148 | 5,722 | 2,514 | 15,791 | 10,599 | 843 |
| 1912[2] | 74,644 | 36,032 | 6,238 | 1,368 | 5,240 | 2,617 | 16,149 | 10,265 | 816 |
| 1913 | 77,010 | 38,092 | 6,767 | 1,446 | 5,540 | 2,686 | 16,144 | 11,164 | 950 |
| 1914 | 80,011 | 39,095 | 7,137 | 1,343 | 5,957 | 2,730 | 15,390 | 11,319 | 1,034 |
| 1915 | 81,845 | 40,530 | 7,157 | 1,457 | 5,758 | 2,795 | 14,585 | 10,978 | 897 |
| 1916 | 82,726 | 44,823 | 7,158 | 1,637 | 6,487 | 3,090 | 15,682 | 12,524 | 1,014 |
| 1917 | 84,447 | 48,347 | 7,890 | 2,081 | 8,121 | 3,634 | 15,921 | 14,524 | 1,485 |
| 1918 | 86,649 | 52,950 | 9,503 | 2,680 | 10,982 | 3,946 | 12,883 | 14,069 | 2,114 |
| 1919 | 87,801 | 59,900 | 9,986 | 2,907 | 13,242 | 3,838 | 12,830 | 11,767 | 2,346 |

| Beginning of year | Manufacturing machinery, tools, etc. | Manufactured products | Imported merchandise | Automobiles | Clothing, personal ornaments, furniture, etc. | Total internal physical wealth | Property rights in foreign countries | Total current valuation of wealth |
|---|---|---|---|---|---|---|---|---|
| 1909 | $5,037 | $11,107 | $623 | $301 | $10,552 | $164,241 | $ −1,637 | $162,604 |
| 1910 | 5,366 | 14,261 | 754 | 431 | 11,167 | 173,822 | −1,697 | 172,125 |
| 1911 | 5,727 | 15,018 | 757 | 587 | 11,931 | 185,701 | −1,757 | 183,944 |
| 1912[2] | 6,091 | 14,694 | 827 | 697 | 12,062 | 187,739 | −1,817 | 185,922 |
| 1913 | 6,377 | 16,591 | 906 | 731 | 12,662 | 197,077 | −1,877 | 195,200 |
| 1914 | 6,557 | 17,805 | 983 | 768 | 13,055 | 203,208 | −1,937 | 201,271 |
| 1915 | 6,636 | 16,726 | 863 | 1,026 | 13,133 | 204,420 | −1,372 | 203,048 |
| 1916 | 7,020 | 19,613 | 1,186 | 1,200 | 14,021 | 218,233 | + 338 | 218,571 |
| 1917 | 8,389 | 30,064 | 1,442 | 1,622 | 15,656 | 243,684 | +2,455 | 246,139 |
| 1918 | 10,366 | 39,377 | 1,602 | 2,484 | 17,140 | 266,783 | +5,364 | 272,147 |
| 1919 | 12,002 | 43,461 | 1,719 | 4,380 | 18,278 | 284,498 | +9,647 | 294,145 |

[1] For mode of estimation, see the text.

[2] The figures for this year are taken from the U. S. Census of Wealth, Debt, and Taxation.

in such a manner as to make it easy to separate out exactly the material desired, the study mentioned furnishes sufficient information to make it possible to approximate the totals sought. The material in the *Review* has been supplemented somewhat by figures derived from Mr. Walter R. Ingalls' recent book on the *Wealth and Income of the American People.* It is well to note the fact that Dr. B. M. Anderson's estimates[1] would indicate for the post-war years the existence of unfunded claims against European debtors much larger in amount than those shown by the Harvard studies. Since, however, many of these claims are of doubtful value, it seems wise to base our figures upon the lower rather than upon the higher estimates.

Table I shows that the valuation placed by the American people upon the physical wealth within the country has increased during each year of the decade. The rate of increase has varied, however, being much larger for the years since 1915 than it was for previous years. This more rapid increase presumably means that because of the increase in current prices people generally believed that the money-income from a typical piece of property would in the future be larger than it had been in the past.

The last column of the table shows that the inclusion of claims against foreign countries makes the nominal increase since 1916 in the value of the total wealth much greater than the increase in the value of the physical wealth alone. The present worth of these claims against foreign nations is at present, however, probably less than their face value because of the fear that payment may be defaulted when the amounts come due.

(*To be concluded.*)

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[1] Published in the bulletins of the Chase National Bank.

# THE INFLUENCE OF THE BUSINESS CYCLE ON CERTAIN SOCIAL CONDITIONS

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The influence of economic changes on social conditions has for a long time been a subject of study for historians, economists, and sociologists. We know that changes in the economic system of a people are accompanied by profound social changes. Thus, the industrial revolution of the past century brought changes in political organization, in the family, the position of women, industrial classes, education, etc. Such effects are the materials back of the theory of the economic interpretation of history.

There is, however, another type of economic changes which also occasions social modifications. These changes are not the lasting changes in the economic order but are oscillatory changes of short duration. Thus, while time brings enduring change, there are also brief swings in economic conditions through prosperity and depression, around the line of general economic change. These fluctuations in business conditions occur over short intervals with some regularity and are usually referred to as business cycles. Do these fluctuations in business produce fluctuations in social conditions? Do we find relatively more births, deaths, marriages, and divorces in periods of business depression? Does crime and do other social phenomena fluctuate with the business cycle? Of course the fact that social statistics fluctuate simultaneously with indexes of the business cycle does not necessarily prove a causal influence, that is, that the economic changes produce the social changes. For instance, if the birth rate is correlated with the business cycle, such a change in the birth rate may not be due directly to the business cycle but may perhaps be due to the changes in the marriage rate, which may correspond to changes in the business cycle. Our first problem, however, is to determine the amount of concurrence in the fluctuations of certain social conditions with the fluctuations of business.

It is possible to measure the amount of this concurrence in several social phenomena, for in some cases we have series of statistics going back a number of years. Furthermore, during the last few years a great deal of success has been achieved in describing the business cycle, and there also exists the technique for measuring quantitatively the concurrence in fluctuations in time series. In the following pages, therefore, we shall inquire to what extent certain data of marriages, divorces, births, deaths, and crime vary with the indexes of the business cycle. Our first step is to measure the cycles of business during recent years.

## I

One difficulty in getting a measure of the business cycles to correlate with social statistics for so large and varied an area as the United States is the diversity of our economic life. Our economic life consists in the main of agriculture on the one hand, and of manufacturing, mining, and trade on the other. The products of agriculture are affected in large part by rainfall and climate; oscillations in crops were in early times referred to as good years and lean years, famines being the extremes of the lean period. The business cycle is a phenomenon more characteristic of the period of great manufacturing development. However, during the last half century in the United States there has been a fairly close relationship between economic welfare in agriculture and in manufacturing. Prosperity and depression in business affect the profits from agriculture, if not so much the volume of agricultural production.

The problem of procuring data which are representative of the state of manufacturing and commerce has been already satisfactorily met. Business failures, prices, volume of production, banking data, and employment are sufficiently widely representative.

Representative indexes must also have one other attribute. They must fluctuate concurrently. The analyses, particularly of Persons and of Mitchell, show that there are a number of economic series that reach their maximum when general prosperity is at its greatest height and reach their minimum when business depression is at its lowest depth. There are also various other series which, when measured in months, reach their maximum at various intervals preceding or following the peak of general business prosperity. Years of research by various economists have resulted in an excellent description in quantitative terms of the cycle of business based on a combination of these representative synchronous series.

We wished to take a curve of the business cycle already constructed but could find none covering a sufficient number of years. Most of the curves of business cycles are for very recent years. Persons has carried his data back to 1879, and Axe has constructed a curve by months to 1877, though he has not published an account of how his curve was constructed. Since it was desirable to have as long a period as possible, we have constructed a curve from 1870 to 1920. In

TABLE I

SOCIAL DATA TO BE COMPARED WITH BUSINESS CYCLES

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| | Number of persons married during year per 1,000 population for certain states | Number of divorces granted per 100,000 population for U. S. | Number of deaths per 1,000 population for selected states | Number of deaths of infants under one year of age per 1,000 births for selected states | Number of deaths from tuberculosis per 100,000 population for selected states | Number of births, including still-births, per 1,000 population for selected states | Number of convictions for criminal offenses in New York state | Number of suicides per 100,000 population in one hundred American cities |
| 1870.... | 18.60 | 28 | 14.63 | 134.1 | 246 | 24.41 | 2,151 | .... |
| 1.... | 19.06 | 29 | 13.97 | 118.8 | 235 | 24.46 | 2,340 | .... |
| 2.... | 19.01 | 30 | 17.36 | 157.9 | 253 | 25.61 | 2,298 | .... |
| 3.... | 19.34 | 31 | 16.76 | 141.0 | 246 | 26.99 | 2,919 | .... |
| 4.... | 18.58 | 32 | 15.25 | 133.1 | 227 | 26.09 | 3,368 | .... |
| 5.... | 16.92 | 32 | 15.77 | 135.9 | 242 | 25.31 | 3,420 | .... |
| 6.... | 15.92 | 33 | 15.35 | 127.2 | 227 | 24.67 | 3,451 | .... |
| 7.... | 15.56 | 34 | 14.36 | 120.3 | 227 | 23.94 | 3,827 | .... |
| 8.... | 15.82 | 34 | 13.88 | 116.0 | 218 | 23.57 | 3,829 | .... |
| 9.... | 16.34 | 35 | 14.13 | 117.1 | 209 | 22.63 | 3,216 | .... |
| 1880.... | 17.42 | 39 | 14.94 | 125.4 | 215 | 22.38 | 2,847 | .... |
| 1.... | 17.96 | 40 | 15.83 | 135.0 | 226 | 22.38 | 2,923 | .... |
| 2.... | 18.74 | 42 | 15.24 | 125.0 | 217 | 22.74 | 2,887 | .... |
| 3.... | 18.68 | 43 | 15.29 | 119.0 | 219 | 23.57 | 2,474 | .... |
| 4.... | 17.42 | 42 | 15.10 | 132.3 | 217 | 23.34 | 2,315 | .... |
| 5.... | 16.76 | 42 | 14.88 | 126.8 | 211 | 23.14 | 2,491 | .... |
| 6.... | 17.28 | 44 | 14.61 | 131.1 | 207 | 23.07 | 2,860 | .... |
| 7.... | 17.92 | 47 | 15.55 | 129.5 | 200 | 24.06 | 3,301 | .... |
| 8.... | 17.76 | 48 | 16.17 | 135.0 | 201 | 24.37 | 3,243 | .... |
| 9.... | 17.96 | 52 | 15.21 | 128.8 | 184 | 24.47 | 3,156 | .... |
| 1890.... | 18.06 | 53 | 15.79 | 130.9 | 191 | 24.74 | 3,364 | .... |
| 1.... | 18.40 | 55 | 15.96 | 133.2 | 174 | 25.38 | 3,607 | .... |
| 2.... | 19.78 | 56 | 16.65 | 135.3 | 177 | 24.85 | 3,202 | .... |
| 3.... | 18.20 | 56 | 16.23 | 136.1 | 171 | 25.23 | 3,283 | .... |
| 4.... | 16.58 | 55 | 15.14 | 136.0 | 167 | 24.24 | 2,940 | .... |
| 5.... | 17.50 | 58 | 15.45 | 134.4 | 171 | 24.22 | 4,468 | .... |
| 6.... | 17.50 | 61 | 15.36 | 135.1 | 162 | 25.07 | 3,768 | .... |
| 7.... | 16.66 | 62 | 14.42 | 124.0 | 153 | 24.17 | 4,523 | .... |
| 8.... | 16.64 | 65 | 15.31 | 136.8 | 151 | 23.75 | 3,567 | .... |
| 9.... | 17.34 | 69 | 16.00 | 137.1 | 146 | 22.68 | 3,861 | .... |
| 1900.... | 17.80 | 73 | 16.69 | 156.8 | 144 | 23.09 | 4,116 | 15.4 |
| 1.... | 18.00 | 79 | 15.68 | 136.0 | 140 | 22.40 | 4,431 | 15.6 |
| 2.... | 19.58 | 78 | 14.96 | 132.2 | 130 | 22.56 | 4,516 | 16.7 |
| 3.... | 18.88 | 81 | 15.46 | 135.2 | 126 | 22.56 | 3,931 | 18.0 |
| 4.... | 17.78 | 81 | 15.11 | 130.0 | 132 | 22.74 | 4,685 | 18.7 |
| 5.... | 18.48 | 82 | 15.45 | 139.2 | 127 | 22.44 | 4,942 | 18.2 |
| 6.... | 19.48 | 86 | 15.62 | 136.5 | 123 | 24.47 | 5,143 | 16.8 |
| 7.... | 19.98 | .. | 15.76 | 127.1 | 123 | 24.96 | 5,529 | 18.8 |
| 8.... | 17.56 | .. | 15.02 | 125.4 | 116 | 25.62 | 7,351 | 21.5 |
| 9.... | 18.38 | .. | 14.71 | 123.7 | 112 | 24.66 | 6,857 | 20.4 |
| 1910.... | 19.08 | .. | 15.53 | 127.9 | 113 | 24.95 | 6,046 | 19.6 |
| 1.... | 19.22 | .. | 14.81 | 112.9 | 108 | 24.99 | 6,657 | 20.4 |
| 2.... | 19.38 | .. | 14.49 | 109.2 | 102 | 25.25 | 7,336 | 19.4 |
| 3.... | 19.64 | .. | 14.58 | 106.5 | 101 | 25.47 | 7,765 | 19.7 |
| 4.... | 19.78 | .. | 14.15 | 101.4 | 101 | 25.59 | 9,088 | 20.9 |
| 5.... | 19.18 | .. | 13.98 | 95.3 | 102 | 25.63 | 10,158 | 20.8 |
| 6.... | 21.56 | .. | 14.91 | 97.3 | 105 | 26.07 | 7,218 | 18.0 |
| 7.... | 22.22 | .. | 14.93 | 92.3 | 107 | 26.39 | 7,930 | 16.7 |
| 8.... | 16.80 | .. | 18.90 | 100.1 | 115 | 26.55 | 7,244 | 14.6 |
| 9.... | 21.00 | .. | 13.43 | 86.3 | 94 | 23.94 | 8,047 | 14.3 |
| 1920.... | 23.06 | .. | 14.02 | 88.8 | 84 | 25.04 | 6,856 | 12.3 |

TABLE II

CYCLES OF BUSINESS AND SOCIAL CONDITIONS

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|
| | Cycles[1] of business indexes | Cycles of marriage rates | Cycles of divorce rates | Cycles of death rates | Cycles of infant death rates | Cycles of tuberculosis death rates | Cycles of birth rates | Cycles of crime rates | Cycles of suicide rates |
| 1870 | −0.15 | +0.25 | −0.91 | −1.44 | −0.20 | +0.26 | −2.33 | +0.33 | ...... |
| 1 | +0.72 | +0.76 | −0.46 | −2.28 | −2.09 | −0.76 | −1.70 | −0.24 | ...... |
| 2 | +1.15 | +0.90 | −0.07 | +3.00 | +3.34 | +1.38 | +0.45 | −1.14 | ...... |
| 3 | +0.91 | +1.18 | +0.23 | +2.23 | +1.19 | +0.81 | +2.88 | +0.02 | ...... |
| 4 | +0.25 | +0.58 | +0.49 | +0.07 | +0.23 | −1.07 | +2.12 | +0.71 | ...... |
| 5 | −0.65 | −0.88 | −0.29 | +0.95 | +0.74 | +0.83 | +1.46 | +0.56 | ...... |
| 6 | −1.18 | −1.76 | −0.20 | +0.40 | −0.38 | −0.57 | +0.94 | +0.41 | ...... |
| 7 | −1.08 | −2.03 | −0.20 | −1.07 | −1.26 | −0.34 | +0.21 | +1.19 | ...... |
| 8 | −1.63 | −1.74 | −1.01 | −1.77 | −1.79 | −1.07 | −0.07 | +1.15 | ...... |
| 9 | −0.95 | −1.21 | −1.04 | −0.95 | −1.57 | −1.82 | −1.25 | −0.23 | ...... |
| 1880 | +0.55 | −0.15 | +1.47 | −0.12 | −0.36 | −0.83 | −1.46 | −1.03 | ...... |
| 1 | +0.73 | +0.42 | +1.30 | +1.26 | +1.03 | +0.83 | −1.39 | −0.79 | ...... |
| 2 | +0.93 | +1.18 | +1.92 | +0.30 | −0.36 | +0.13 | −0.80 | −0.75 | ...... |
| 3 | +0.52 | +1.15 | +1.63 | +0.33 | −1.21 | +0.76 | +0.42 | −1.65 | ...... |
| 4 | −0.31 | −0.02 | −0.23 | −0.02 | +0.69 | +0.94 | 0.00 | −1.94 | ...... |
| 5 | −0.82 | −0.63 | −0.94 | −0.47 | −0.11 | +0.63 | −0.45 | −1.51 | ...... |
| 6 | −0.19 | −0.13 | −0.85 | −0.98 | +0.47 | +0.60 | −0.76 | −0.36 | ...... |
| 7 | +0.61 | +0.48 | +0.26 | +0.33 | +0.20 | +0.18 | +0.45 | +0.85 | ...... |
| 8 | +0.53 | +0.32 | −0.20 | +1.09 | +0.92 | +0.86 | +0.63 | +0.76 | ...... |
| 9 | +0.36 | +0.50 | +1.34 | −0.49 | −0.04 | −0.88 | +0.38 | +0.56 | ...... |
| 1890 | +0.96 | +0.56 | +0.91 | +0.19 | +0.18 | +0.65 | +0.35 | +1.06 | ...... |
| 1 | +0.70 | +0.88 | +1.01 | +0.21 | +0.42 | −1.12 | +0.42 | +1.64 | ...... |
| 2 | +0.93 | +2.14 | +0.52 | +1.23 | +0.60 | −0.05 | −0.10 | +0.43 | ...... |
| 3 | +0.02 | +0.61 | −0.59 | +0.65 | +0.60 | −0.29 | +0.69 | +0.42 | ...... |
| 4 | −1.37 | −0.96 | −2.12 | −0.95 | +0.42 | −0.47 | −0.45 | −0.60 | ...... |
| 5 | −0.52 | −0.13 | −1.53 | −0.47 | +0.07 | +0.91 | −0.17 | +2.68 | ...... |
| 6 | −1.23 | −0.20 | −0.98 | −0.56 | 0.00 | +0.26 | +1.32 | +0.71 | ...... |
| 7 | −1.15 | −1.03 | −1.50 | −1.91 | −1.62 | −0.47 | +0.35 | +1.96 | ...... |
| 8 | −0.73 | −1.13 | −1.01 | −0.56 | −0.11 | −0.08 | +0.07 | −0.45 | ...... |
| 9 | +0.12 | −0.53 | −0.16 | +0.53 | −0.63 | −0.18 | −1.18 | −0.26 | ...... |
| 1900 | +0.21 | −0.20 | +0.62 | +1.63 | +2.06 | +0.18 | −0.21 | −0.17 | −0.27 |
| 1 | +0.19 | −0.10 | +2.28 | +0.19 | −0.43 | +0.16 | −1.01 | +0.02 | −0.52 |
| 2 | +0.60 | +1.26 | +0.72 | −0.81 | −0.70 | −1.04 | −0.24 | −0.29 | +0.12 |
| 3 | +0.26 | +0.53 | +0.91 | +0.02 | −0.07 | −1.15 | +0.14 | −1.61 | +1.08 |
| 4 | −0.37 | −0.56 | −0.13 | −0.44 | −0.52 | +0.73 | −0.14 | −0.81 | +1.19 |
| 5 | 0.00 | −0.05 | −0.68 | +0.19 | +1.01 | +0.39 | −1.35 | −0.82 | −0.12 |
| 6 | +0.52 | +0.75 | −0.13 | +0.56 | +0.96 | +0.21 | +0.90 | −0.95 | −2.20 |
| 7 | +0.90 | +1.05 | ...... | +0.88 | −0.04 | +0.83 | +0.97 | −0.72 | −0.54 |
| 8 | −0.97 | −1.20 | ...... | −0.14 | +0.11 | −0.10 | +1.35 | +1.19 | +1.79 |
| 9 | +0.08 | −0.60 | ...... | −0.48 | +0.25 | −0.44 | −0.42 | +0.24 | +0.31 |
| 1910 | +0.46 | −0.12 | ...... | +0.91 | +1.32 | +0.34 | −0.38 | −0.97 | −0.81 |
| 1 | −0.17 | −0.13 | ...... | −0.07 | −0.52 | −0.34 | −0.63 | −0.53 | −0.10 |
| 2 | +0.26 | −0.13 | ...... | −0.42 | −0.63 | −1.30 | −0.48 | −0.05 | −1.00 |
| 3 | +0.34 | −0.07 | ...... | −0.14 | −0.58 | −1.12 | −0.35 | +0.20 | −0.52 |
| 4 | −0.66 | −0.10 | ...... | −0.65 | −0.88 | −0.70 | −0.24 | +1.36 | +1.14 |
| 5 | −0.70 | −0.73 | ...... | −0.77 | −1.37 | −0.08 | −0.21 | +2.27 | +1.85 |
| 6 | +0.62 | +1.06 | ...... | +0.93 | −0.38 | +1.04 | +0.45 | −0.68 | −0.35 |
| 7 | +1.08 | +1.43 | ...... | +1.14 | −0.63 | +1.88 | +1.04 | −0.02 | −0.48 |
| 8 | +1.25 | −3.11 | ...... | ...... | +1.68 | +4.27 | +1.46 | −0.64 | −1.46 |
| 9 | +0.35 | +0.10 | ...... | −1.12 | −0.25 | −1.07 | −1.80 | +0.26 | +0.46 |
| 1920 | +0.81 | +1.54 | ...... | +0.07 | +1.19 | −0.96 | +0.07 | −0.74 | +0.50 |

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[1] The cycles are in units of the standard deviation.

working out a single series to describe the business cycle we have chosen to combine the following series:

1. Wholesale prices, 1870–1915.[1]
2. Commercial failures, 1870–1920.[2]
3. Bituminous coal production, 1870–1920.[3]
4. Pig iron production, 1870–1920.[4]
5. Railroad freight ton mileage, 1882–1920.[4]
6. Bank clearings outside New York, 1881–1915.[5]
7. Employment in Massachusetts, 1889–1920.[6]
8. Railroad mileage constructed, 1870–88.[7]
9. Imports, 1870–88.[8]

These series have all been studied by others, and their yearly fluctuations are shown to have a high correlation [9] and to represent widely different types of economic phenomena. They are also probably sufficient in number to average out certain errors due to inadequacies in fitting trend lines and to such deviations of particular series from the true business cycle as may be found here and there.

The next step was to determine the cycles for each series. The data for most of these nine series when plotted showed a general upward movement for the whole period, with small fluctuations up and down around the line of the general upward movement. (A similar upward movement is seen in the curve of divorce rates shown in Chart III.) To each series lines were then fitted which appeared to describe the general movement. These lines are called the trend lines.[10] The actual data deviated in each year above or below these trend lines. (In Chart III, showing divorce rates, similar trend lines and deviations of the data from the trend lines are shown.) These deviations of the actual data from the trend for each year were computed in percentages of the trend data for the respective years. Then each percentage deviation was divided by the standard deviation of these percentage deviations for the particular series. The results were the cycles for the particular series in terms of their respective standard deviations as units. (Similar cycles for the divorce data are seen in column 3 of Table II.) The arithmetic mean, unweighted, was then found for the cycles of the nine series. The result is a single series describing the business cycle for the period and is seen plotted as curve A in Chart I. The indexes of the cycles are listed in column 1 of Table II.

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[1] *U. S. Bureau of Labor Statictics, Bulletin 149*, p. 179; and *Monthly Labor Reviews.*

[2] The ratio of commercial failures to firms in business. Dun's Review. *Statistical Abstract of the United States.* Dun's figures of the number of firms in business.

[3] *U. S. Geological Survey, Mineral Resources of the U. S.*, 1917, p. 924 and later releases.

[4] *Statistical Abstract of the U. S.*

[5] *Commercial and Financial Chronicle.*

[6] Indexes of employment in manufacturing industries in Massachusetts. Ralph G. Burlin, "Three Decades of Employment Fluctuation," *The Annalist*, vol. 18, pp. 387–88, Oct. 24, 1921.

[7] *World Almanac*, 1922, p. 184.

[8] Value of Imports. U. S. National Monetary Commission, Statistics for the United States, 1867–1909.

[9] Warren M. Persons, "The Construction of a Business Barometer," *The Amer. Economic Rev.*, vol. VI, No. 4, Dec. 1916; and *Indices of General Business Conditions.*
*The Review of Economic Statistics* (various issues).

[10] The trend lines for the various series are the following. The origins for these equations and all others listed are at the midyear of the period unless otherwise stated.

1. Wholesale prices, 1870–96, $y=96.57-2.93x+0.06636x^2$; and, 1897–1915, $y=90.4+1.847x-0.07335x^2$.
2. Commercial failures, 1870–1920, $y=0.966-0.0043x$.

In constructing this curve showing the fluctuations of business for the past fifty years, the chief methodological difficulty was in selecting the equations of the trend lines that seemed to describe best the general movement of the particular series. As there was no mechanical test to show which particular line best described the true trend of the data, it was largely a matter of judgment of the eye. For instance, one investigator might think that the trend of wholesale prices from

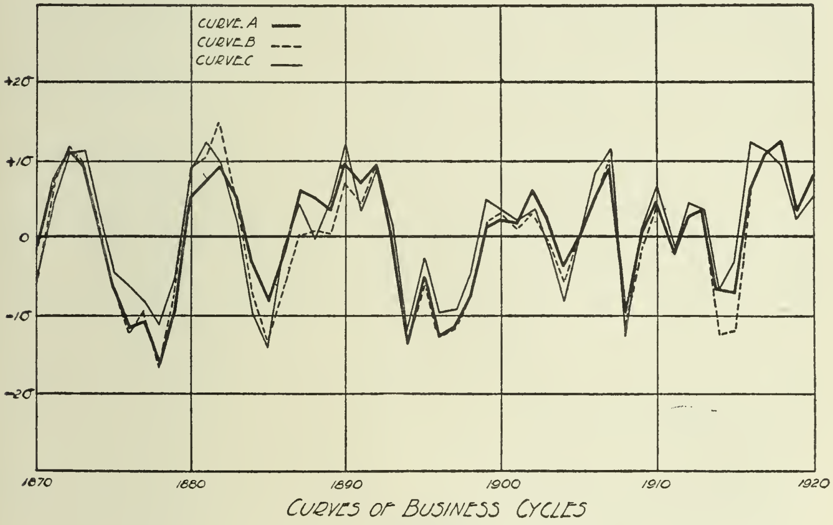

CHART I

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3. Bituminous coal production, 1870–1892, $y=7760.8+631.22x+19.41x^2$; 1902–14, $y=37374+1673\,x-54\,x^2$; and 1914–20, projected.

4. Pig iron production, 1870–94, $y=4218.34+306.02+6.53x^2$; 1894–1904, $y=12888.09+1140.96x$ 1904–14, $y=24298.81+785.79\,x$; and 1914–20, projected.

5. Freight ton mileage, 1882–1914, $y=120.88+8.076\,x+0.2009\,x^2$; and 1914–20, projected.

6. Bank clearings outside New York, 1881–1915, $y=31389+1982.54\,x+56.23\,x^2$.

7. Employment, 1889–1905, $y=62.47+1.818x+0.1644x^2$; 1905–15, $y=95.91+1.35x$; and 1916–20, projected.

8. Railroad mileage constructed, 1870–88, $y=5754.37+236.3\,x$.

9. Imports, 1870–88, $y=5691+108\,x$.

1870 to 1896 was that best described by a straight line, and another investigator might prefer a parabola.

In order to get around this difficulty of individual bias, which as a source of error, however, may be limited, we decided to check our results by constructing another curve of the business cycle by computing the cycles of each series from trend lines consisting of nine-year moving averages.[1] This was done, and the result is curve B in Chart I. It is seen to be remarkably similar to curve A, the coefficient of correlation of the two curves being +0.95.

Because of the fact that there may be a variation in preference on the part of different investigators in choosing equations to describe trends, it is of value to compare our curve of business cycles, curve A in the chart, with the curve constructed by Axe. Axe's curve is not constructed from identically the same series,[2] and it is for intervals of a month. It was reduced to a yearly basis by adding the monthly cycle indexes and dividing by twelve. As this curve goes back only to 1877, we pieced it out by joining on a cycle from 1867 to 1877 constructed from several economic series available for those years.[3] The resulting curve, thus extended, is plotted as curve C in Chart I. It is quite similar to curve A, the coefficient of correlation being +0.92.

From the foregoing considerations, then, we think that the cycle

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[1] The moving averages were plotted at the midyear of each nine-year period. The trend lines of moving averages extended over the following years for the various series:

1. Wholesale prices, 1867–1912.
2. Commercial failures, 1868–1914.
3. Bituminous coal production, 1867–1916
4. Pig iron production, 1867–1916.
5. Railroad freight ton mileage, 1887–1916.
6. Bank clearings outside New York, 1884–1911.
7. Employment in Massachusetts, 1893–1916.
8. Railroad mileage constructed, 1867–86.
9. Imports, 1871–92.

[2] Axe's curve was published in the *New York Evening Post*, Oct. 17, 1921, in an article by Wesley C. Mitchell. The curve was not described, the trend lines not given, nor the years covered by the various series. The series combined in the curve were weighted with the following weights:

| | |
|---|---|
| Bank clearing outside New York | 25 |
| Pig iron production | 20 |
| Railroad traffic | 15 |
| Failures | 10 |
| Copper production | 5 |
| Cotton consumption | 10 |
| Coal production | 5 |
| Commodity prices | 10 |
| | 100 |

[3] The segment from 1867 to 1877 was constructed by averaging the cycles derived from straight-line trends for the following series: Railroad mileage constructed; imports and exports (fiscal years); immigration (fiscal years); pig iron production; bituminous coal production; commercial failures; wholesale prices; cotton consumption. The standard deviations for this segment are based on yearly data, while for the series in Axe's curve they are based on monthly data. There is, for this reason, perhaps some error in joining the two curves, but it does not appear to be large.

series in column 1 of Table II is a sufficiently satisfactory measure of the business fluctuations from 1870 to 1920 to use in correlation with the data of certain social phenomena.

## II

For a study of the variations in marriage rates the only data that have been collected for the United States as a whole are from 1866 to 1906. Since it was desirable to have a longer record, we have collected the figures for the number of persons married during the year for the period 1870–1920 for the states for which satisfactory statistics were available. These states are Connecticut, Massachusetts, Michigan, New Hampshire, Rhode Island, and Vermont. The rates [1] for these states are listed in column 1 of Table I. A parabola[2] seems to describe the general movement of the marriage rates as seen in Chart II. The fluctuation of these marriage rates around the trend appears to be, in general, concurrent with the cycles of business indexes, as is seen by comparing the marriage cycles listed in column 2, Table II, with the business cycles listed in column 1, the coefficient of correlation being +0.66. Although in general the marriage rate increases in prosperity and diminishes in depression, this is rather noticeably not true in the year 1918. The marked drop in the marriage rate in this very prosperous year is thought to be due to the extraordinary conditions of war time. If we omit from the correlation table the data for the year 1918, the correlation becomes +0.87. When the cycles of marriage rates are computed from a trend of nine-year moving averages their correlation with the business cycles for 1874–1916 is +0.81.

Similar results have been found by others. In 1901 Hooker obtained a coefficient of correlation of +0.86 between the marriage rate in England and Wales and the amount of foreign trade for the period 1861–95, the cycles being measured from seven-year moving averages.[3] For the United States, Davies found a correlation between the marriage rate and wholesale prices, 1887–1906, of +0.67.[4] This checking of results from different data by different investigators leaves no doubt as to the fact that the number of marriages fluctuates with business conditions.

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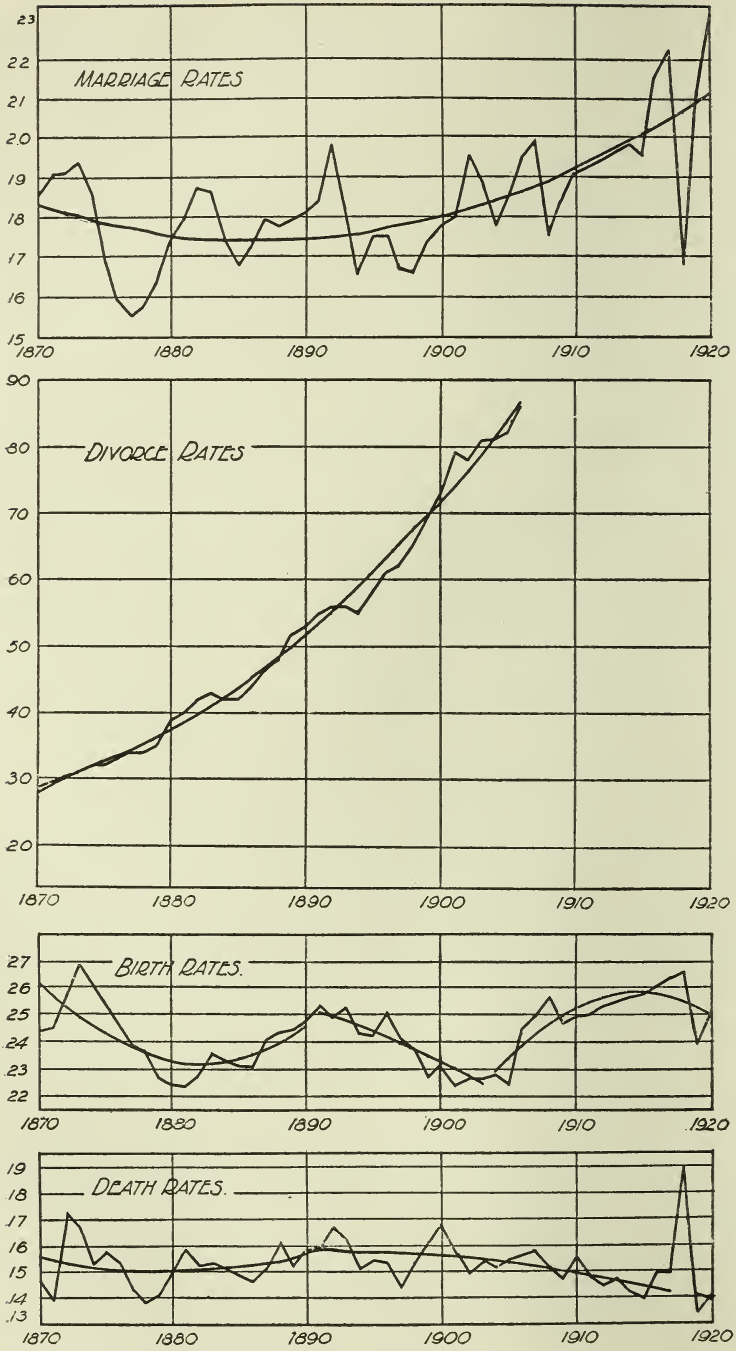
[1] The population of these states, used in computing the rates, was found by interpolation for the intercensal years, on the assumption of a constant rate of change. During the last decade when the changes in population were somewhat unusual, the results of the state censuses helped in making the interpolation.

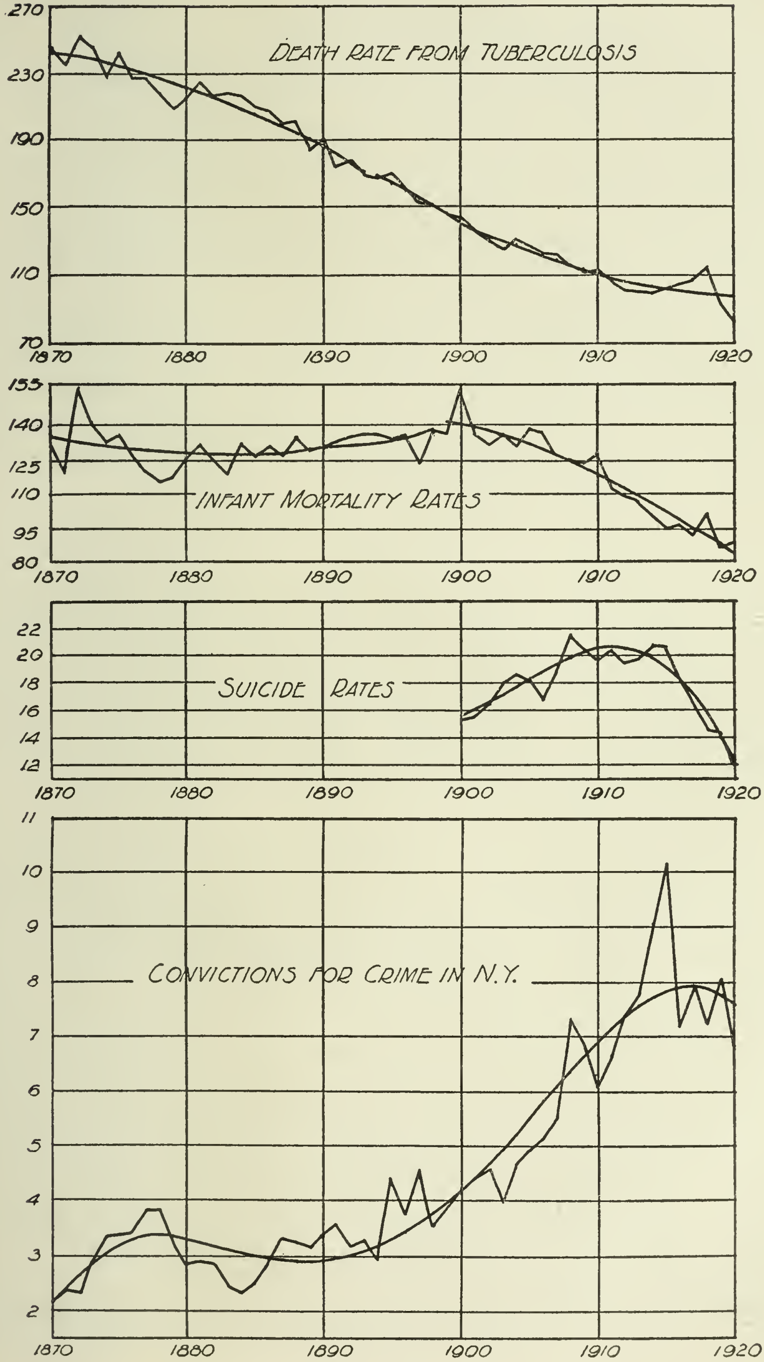
[2] $y = 17.65 + 0.055\,x + 0.0032\,x^2$.

[3] R. H. Hooker, "On the Correlation of the Marriage Rate with Foreign Trade," *Jour. of the Royal Statis. Soc.*, vol. LXIV, p. 485.

[4] George R. Davies, "Social Aspects of the Business Cycle," *Quar. Jour. of the Univer. of N. D.*, vol. XII, No. 2, Jan., 1922.



Charts II, III, IV, and V



CHARTS VI, VII, VIII, AND IX

That the marriage rate should be greater when business is good and less when business is bad appears to be what one would expect. Yule thinks that one reason for the very large degree of correlation is probably the fact that the non-occurrence of the event in a business depression means in many cases only a postponement until business prosperity returns. The changes in the marriage rate seem to be practically simultaneous with changes in the business cycle. When the correlation is made between the indexes of the business cycle and changes in the marriage rates, not of the same year but of the following year, the coefficient of correlation (omitting the data for 1918) is +0.62, smaller than the coefficient when the correlation is made without the assumption of a one-year lag. Hooker finds that the correlation is a maximum with a lag of about a third of a year. The correspondence in the fluctuations of the marriage rate and the business cycle seem to be a little closer for the earlier years than for the later year, from both the British and the American data.

## III

That the divorce[1] rate is influenced by business conditions was noted by Willcox[2] as early as 1893. The curve of divorce rates for the United States from 1866 to 1886 showed low divorce rates in the periods 1873–79 and 1884–86, which Willcox observed were periods of depression in trade. The similarity in the drops in the curve of divorce rates and the curve of trade was so close as to lead to the conclusion of a causal relationship.

Since the publication of Willcox's article, the divorce statistics for the United States have been extended to 1906. There has been a marked increase in the divorce rate, as is seen in the Chart III. Chart III also shows the trend line describing the upward movement.[3] The fluctuations around this trend line correspond quite closely to the fluctuations of the business cycles, the correlation for the forty years, 1867–1906, being +0.70.[4]

The tendency to secure more divorces in prosperity and fewer divorces in business depression is quite marked, and this conclusion is perhaps surprising. The reason is not clear, although the economic argument is clearer than the psychological. The fact that divorces are expensive, involving lawyers' and court fees and perhaps alimony, may be the reason for relatively more divorces in times of business prosperity. It would be interesting to know whether there are also more desertions in periods of prosperity. It would also be interesting to know what psychological factors are involved in decreasing the divorce rate in times of business depression.

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[1] We are indebted to Miss Helen Mack for assistance in the study of divorce rates and the business cycle.

[2] Walter F. Willcox, "A Study in Vital Statistics," *Polit. Sci. Quar.*, vol. VIII, No. 1.

[3] $y = 46.685 + 1.542\,x + 0.0289\,x^2$.

[4] The business-cycle curve used in this correlation was constructed from nine-year moving-average trends.

On account of the fact that time is involved in the court procedure of granting divorces, we might be led to expect a lag in the variations in the divorce rate corresponding to the business cycle. The correlation is, however, lower with a one-year lag in the divorce rates, being +0.58.

We have been able to procure the divorce rates for thirteen states [1] through 1920. The correlation between the business cycles for the United States and the divorce cycles for the thirteen states is lower (+0.33) than the correlation between the former and the divorce cycles of the United States as a whole for the shorter period. The lack of correspondence between the divorce cycles of the thirteen states and the business cycles appears to be greater for the earlier years, however, than for the later years. Also, from an inspection of the curves of divorce rates as published in the census volumes for separate sections of the United States, such as the South Atlantic States and the North Central States, it appears that there is a less close correspondence in fluctuations with the business cycle than there is for the nation as a whole. Just why these samples should show lower correspondences than the whole, we do not know. Possible causes may be changes in laws, migrations, changes in residence, or the influence of crop cycles.

## IV

Statistics of the annual death rate for the registration area go back only to 1900. We were able to obtain the death rates from 1870 to 1920, however, for the same states for which we secured marriage rates. The fluctuations in the curve of these death rates seem to correspond somewhat with the business cycles. The correlation [2] is found to be positive and fairly high, $r = +0.57$, and with cycles from nine-year moving averages, $r = +0.63$. This is a surprising result, as one would guess that if there were any correlation at all between business conditions and death rates it would be negative, that is, there would be relatively more deaths in business depression and fewer in business prosperity. Such an inference would be drawn, for instance, from the studies of the Children's Bureau, Washington, D. C., which have shown that when the earnings of the father are low, the infant death rates are high. We are also told that pulmonary tuberculosis is a disease of poverty. The impression that disease is more prevalent in conditions of poverty would lead one to expect more deaths in business depression.

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[1] Conn., Ind., Ia., Me., Mass., Mich., N. H., Ohio, R. I., S. D., Utah, Vt., and Wis.

[2] The trend lines for the death rates from which the cycles were computed are, for 1870–90, $y = 15.01 + 0.0035\,x + 0.0062\,x^2$, and for 1891–1920 (omitting 1918), $y = 15.33 - 0.0654\,x - 0.0022\,x^2$.

Assumptions of lags do not clarify the matter. With a one-year lag in the death rate the correlation is +0.49, and with a two-year lag it is +0.03. If we assumed a four- or five-year lag or longer in the influence of the business cycle on the death rate, we should probably get a negative correlation. But what basis is there for such an assumption? Such an assumption would be quite unjustified in the case of infant death rates. Yet the curve of infant death rates for these states is quite similar to the curve of general death rates. Yule has found a correlation of +0.77 between the general death rates in England and Wales and the infant death rates.[1]

The infant mortality rate shows about the same positive correlation with the business cycle as does the general death rate, +0.42, for the same states and for the same period.[2] The correlation, when the trend is nine-year moving averages, is +0.37. And with a one-year lag in the infant mortality rates the correlations are, for these types of trends, +0.43 and +0.29. The infant mortality rates, then, like the general death rates, show the strange result of increasing in prosperity and decreasing in depression.

If the registration bureaus were in the habit of collecting and registering more records in good times and fewer in bad times, this positive correlation would be explained; but persons familiar with the administration of vital statistics assure us that there is no such variation in the registration of death records.

We know that the filing of death records for all deaths does not occur. It has been a long, hard struggle to induce the various states to keep records sufficiently complete to entitle them to be included in the registration area. But even if the statistics of deaths are much less than 100 per cent complete, the partial records might quite conceivably show much the same cyclical fluctuation around a trend that they would if the records were complete. On the other hand, errors in the record may be due to various causes.

It may be that the death rates for the registration area since 1900 are more accurate than the death rates for the selected group of states from 1870 to 1900. We have therefore correlated the death rate for

[1] G. Udny Yule, *Introduction to the Theory of Statistics*, Chap. V, p. 198.

[2] The trend line for the infant mortality rate from which the deviations were measured for correlation with the business cycle is, for 1870–98, $y = 127.47 + 0.067x + 0.0466x^2$; and, for 1898–1920, $y = 122.04 - 2.73x - 0.072x^2$.

the United States registration area, 1900–20, with the business cycle for that period with the same results, $+0.44 \pm 0.12$ for the general rates, and $+0.41$ for the infant mortality rates.[1]

On account of these unexpected results it is desirable to see if they are borne out by statistics for other countries. We have not found any published results of correlations by other investigators of death rates and business conditions. We did, however, examine the mortality rates in England and Wales where the registration of vital statistics has been exceptionally satisfactory. In the absence of a curve of business cycles for England we used as our index of business conditions the amount of foreign trade.[2] The correlation, for the period 1870–1914, of foreign trade with the general death rate is $+0.02$, and with the infant mortality rate is $-0.09$. These results increase our skepticism regarding the existence of a significant correlation between death rates and the business cycle.

Even if there is no correlation of the business cycle with the general death rate, there might be a correlation with specific death rates, although inspection of the curves of some of the classifications of death rates since 1900 does not encourage such an expectation. For the United States, the fact that few states have records going back to 1870 and that only a small number of cases of deaths from specific diseases is recorded makes an inquiry somewhat doubtful. We have, however, correlated the cycles[3] of death rates from tuberculosis of the lungs for certain states[4] with the cycles of business, for the period 1870–1920, and find a correlation coefficient of $+0.32$. If the year 1918 is omitted the correlation becomes $+0.24$, and with a one-year lag it is $+0.16$. For the United States registration area, 1900–20, the correlation is $+0.193$; omitting 1918, it is $-0.05$.[5] The relationship of death rates from pulmonary tuberculosis to the business cycle is much the same as that of the general death rate.

The suicide rate would be expected, we think, to vary with business prosperity and business depression, and so it does. We have taken the suicide rate as computed by Hoffman[6] for one hundred cities of the United States for 1900–20 and correlated the suicide cycles[7] with cycles of business conditions for the same period, and we find a correlation of −0.74 ±0.07.

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[1] The trend for the general death rate, 1900–20, omitting 1918, is $y = 14.69 - 0.192\,x + 0.00025\,x^2$, and for the infant mortality rates, determined by dividing the deaths by the population, is, 1900–20, $y = 271.5 - 6.86\,x - 0.05\,x^2$.

[2] The trend line for the foreign trade is $y = 716.4 + 14.5\,x + 0.596\,x^2$. The trends for other British data were taken from nine-year moving averages.

[3] Trend, 1870–94, $y = 216 - 3.14\,x - 0.72\,x^2$; and 1894–1920, $y = 119.2 - 2.8\,x + 0.086\,x^2$.

[4] Mass., Mich., N. H., and R. I.

[5] Trend $y = 142.7 - 3.4\,x + 0.034\,x^2$.

[6] Frederick L. Hoffman, "Suicide Record for 1920," *Spectator*, March 9, 1922.

[7] The suicide cycles were measured from the trend line $y = 20.35 + 0.171\,x - 0.0656\,x^2 - 0.00348\,x^3$.

From the inquiry, as thus far conducted, into a possible correlation between death rates and business cycles, we do not draw the definite conclusion of a correlation, except in the case of suicides. The evidence for the United States points toward the conclusion that there are somewhat greater death rates in prosperity than in depression; but the British data do not bear out such a conclusion. Although it seemed probable that there would be a negative correlation between death rates and the business cycle, it should be remembered that there are other factors affecting the fluctuations of death rates from year to year. Such factors are climate, health education campaigns, developments of preventive medicine, and epidemics. In a period of fifty years there are only a very few cycles, and if there is an economic influence it might be obscured by variations in other factors, although it could be uncovered by partial correlations if we could procure series of data for the other factors.

## V

For statistics of births in the United States the birth registration area was created in 1915, fifteen years later than the publication of annual deaths from the death registration area. However, we were able to get birth statistics from 1870 to 1920 from the same states from which we obtained mortality statistics. These statistics of birth rates are shown plotted in Chart IV. Looking at this curve we observe that there would be a little more than two cycles if the trend be assumed to be a straight line, which would give little or no correlation with the business cycles. If we assume a trend with two or three bends in it, then we shall get more numerous cyclical fluctuations. The chart shows the trend lines we have fitted.[1] The moving averages of nine years follow very much the same course as these trend lines. The correlation of the fluctuations of the birth rate with the indexes of business is +0.06; when the birth rate fluctuations are measured from the line of nine-year moving averages the correlation is +0.04. The birth rate for England and Wales likewise fails to show a high positive correlation. When correlated with the amount of foreign trade, the British birth rates, 1874–1910, yield a correlation of −0.31.

One expects a positive correlation between the birth rate and the business cycle, if for no other reason than the fact that there are more marriages in prosperity and fewer in depression. But one also expects such a possible positive correlation to appear by comparing the index of the business prosperity not, say, of a particular year with the birth rate of the same year, but with the birth rate of the year following. Making such a correlation on the assumption of a one-year lag, we find for the selected states, 1870–1920, a correlation of $+0.33 \pm 0.07$; for England and Wales, 1874–1910, it is $+0.15 \pm 0.11$. Our correlations indicate, therefore, that there is a slight tendency for birth rates to increase in prosperity after a year's lag and to decrease in depression. This may be due in part to the fact that marriages are so highly correlated with business conditions.

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[1] Trends: 1870–90, $y = 23.37 - 0.0836\,x + 0.0196\,x^2$; 1890–1904, $y = 23.93 - 0.219\,x - 0.0041\,x^2$; 1904–20, $y = 25.62 + 0.135\,x - 0.0268\,x^2$.

## VI

It has been said that in periods of acute business depression and unemployment the prisons are filled. In order to measure the correlation between crime and the business cycle records are needed extending over a long period of time. The Secretary of State of New York publishes such a record of the number of convictions for criminal offenses in Courts of Record. Several other states are reported as having such a record, but we have been unable to secure another state record for an unbroken series of years. Regarding these statistics of convictions, Robinson, in his *Criminal Statistics of the United States*, observes that in no state are the records complete. The statistics are sent in from the different local units, but somewhat irregularly. Although the series for New York State is not complete it is the best available, and we decided to compare the fluctuations of this series of crime statistics with the business cycle.

Observation of this curve of crime statistics, as shown in Chart IX, and its fluctuations around the trend line[1] shows that in most of the depressions the number of convictions is above the normal, as indicated by the trend, and in most of the periods of prosperity the number of convictions is less. The coefficient of correlation is $-0.35 \pm 0.08$; when the trend for the data on convictions is for nine-year moving averages the correlation is the same, $-0.32$. With a one-year lag the coefficient of correlation is smaller, $-0.24$.

The conclusion that there is an increase in convictions for crime in business depression is corroborated by Davies,[2] who correlated the annual admissions to New York State prisons, 1896–1915, with wholesale prices and found a correlation of $-0.41 \pm 0.13$.

The Secretary of State of New York in his report publishes an analysis of the number of convictions, and one of the series is the number of convictions for offenses against the person, exclusive of offenses against property with violence. It is interesting to inquire whether such offenses against the person are correlated with business conditions. The coefficient of correlation is negative, though small, −0.12±0.09.

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[1] $y = 331.93 + 12.633 + 1.1035\, x^2 - 1.002512\, x^3 - 0.00138\, x^4$.

[2] *Loc. cit.*, p. 111.

Our conclusion is, therefore, that although the records of crime statistics are not wholly satisfactory, there does appear to be some negative correlation between convictions for crime and the business cycle, and this conclusion has been corroborated by another investigation from different data.

# THE METHOD OF MONTHLY MEANS FOR DETERMINATION OF A SEASONAL VARIATION

By William L. Hart, *University of Minnesota*

## 1. INTRODUCTION

Many of the mathematical processes used in statistical analysis are of such frequent application and are, relatively, so ancient in their origin that one ceases to think of the reasons for their well-known validity. When a new process is invented, however, it should be subjected to close scrutiny to determine the sphere in which its application is valid. The present paper deals with two methods which have been used for the determination of the seasonal variation in certain statistical data of economics. Arguments are presented against one method,[1] which is relatively complicated in its numerical details, and a complete logical foundation is given for a second method,[2] which involves merely the formation of monthly means.

Before considering the particular problems of this paper it is pertinent to decide on suitable criteria for testing the validity of a mathematical process used in statistical analysis. In the field of pure mathematics we may state certain definite hypotheses and, by logical reasoning, derive certain equally definite conclusions. It is realized, after very brief reflection, that most of the well-established mathematical methods of statistics have been taken over bodily from corresponding problems already solved in the field of pure mathematics. Such statistical methods have perfectly defined spheres of usefulness. We are usually able to state that if our statistical problem, when couched in mathematical terms, satisfies a given set of conditions, then our particular method leads us to conclusions, the accuracy of which is dependable. Many times, moreover, we are also able to state that even when the given set of conditions is not satisfied by our data, nevertheless the conclusions obtained by our method are the best, of a given type, that could possibly be obtained by *any* method.

To illustrate the preceding paragraph, consider the method of least squares for determining a line $y=at+b$ to fit a set of points in a plane containing the rectangular $(y, t)$ axes. This set of points may be considered as the graph of a time series, a table of the values of a variable quantity $y$ for a sequence of values of the time represented by $t$. The following mathematical theorem is the logical basis for our statistical method in the present type of problem:

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[1] Persons, *Rev. of Economic Stat.*, Jan., 1919, p. 5.

[2] E. W. Kemmerer, *Seasonal Variation in the Demand for Money and Capital in the United States*, Report of the National Monetary Commission (1910).

*If the set of points actually lies on a straight line, this is the line which is given by the method of least squares. Moreover, if the points do not lie on a straight line, that line which we obtain by our method is such that the sum of the squares of the distances (measured parallel to the $y$ axis) from the given points to our line is less than would be the case for any other straight line in the $(y, t)$ plane.*

The determination of the secular trend[1] in a time series may be based on this theorem, and our confidence in the results obtained is based upon the knowledge that the secular trend we determine is the best approximation we can hope for, where the word "best" is used in the sense of the method of least squares.

When a mathematical method of statistics is not based upon a theorem from pure mathematics, it is on the same plane as any empirical process. It should be subjected to experimental test in a controlled problem, where the results which should be obtained are known *a priori*. If a sensible problem can be proposed, where the results are known, in which the method in question leads to conclusions at variance with the truth, doubt should be cast upon all conclusions obtained by use of the method. Moreover, if two methods are available, of which one is founded logically and the other only empirically, with a slight doubt, perhaps, as to its general validity, it is obvious that the logically founded method is to be preferred. In the following discussion a logical background is given for the method of monthly means for determining seasonal variation. Afterwards an example of an admitted type is treated by Persons' method, and it is shown that the results obtained are widely at variance with the truth. The method of monthly means gives the correct result in this example.

## 2. THE METHOD OF MONTHLY MEANS

It is presumed that our data consist of a series of monthly entries of the values of some quantity over a series of $k$ consecutive years. It will be supposed that any secular change originally present in the data has been eliminated, for example, by fitting a straight line to the original data by the method of least squares and by then subtracting the ordinates of this straight line from the corresponding entries in the original data. Let $f(t)$ represent the value of our entry $t$ months from the zero date. For simplicity of nomenclature $t=0$ will be spoken of as January of the first year, $t=1$ as February of the first year, $t=12$ as January of the second year, $t=26$ as March of the third year, etc.

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[1] Persons, *loc. cit.*, p. 12.

The method of monthly means for the determination of the seasonal variation in $f(t)$ is described in the following paragraph:

Form a new January entry by taking the arithmetic mean of all the January entries over the $k$ given years; form a February entry by taking the arithmetic mean of all February entries; . . . form a December entry similarly from the December entries over the $k$ years. This series of twelve monthly means is then to be taken as our best approximation to the values which $f(t)$ *would have had* in *all* years at the corresponding months if no causes had been influencing the values except those which lead to seasonal variation.

A seasonal variation is defined as a periodic change with the period one year. The graph of a seasonal variation over a period of one year is *not necessarily a single graceful wave* with a well-defined crest and trough. The essential feature of a strictly seasonal variation is that its numerical value is the same, at corresponding months, in all years. A seasonal variation thus yields the same values for the Januarys of all years, and similar constant results for the other months. Hence, it is obvious that the following theorem is true:

*Theorem* (1). *If $f(t)$ actually is a periodic function whose period is one year, the monthly entries obtained by our method are exactly the values of $f(t)$ at the corresponding months.*

The second theorem we shall state is designed to show explicitly the exact power of the method. Let $P(t)$ represent the periodic function, with the period one year, whose values for all Januarys, Februarys, etc., are the corresponding monthly means obtained above. Thus, $P(0)=P(12)=P(24)$, etc., $=$ the January mean; $P(3)=P(15)=P(27)$, etc., $=$ the April mean, etc.

*Theorem* (2). *Let $f(t)$ be any function of the time $t$ known from $t=0$ to $t=12k$, that is, over a period of $k$ years. Then, the sum of the squares of the residuals $[f(t)-P(t)]$, for all values of $t$, or*

$$(1)\quad [f(0)-P(0)]^2+[f(1)-P(1)]^2+\ .\ .\ .\ +[f(12k-1)-P(12k-1)]^2$$

*is smaller in value than it would be if any other periodic function with period one year were used in place of $P(t)$.*

It is seen that Theorem (2) shows $P(t)$ to be the answer to the following problem:

(2) *To determine a periodic function $P(t)$ which, in the sense of the method of least squares, is the best approximation to $f(t)$.*

The comparison of (2) with the theorem of the introduction shows the analogy between the method of monthly means and the method by which we determine a secular trend. The proof of Theorem (2) is extremely simple. It is well known that the sum of the squares of the deviations of a group of quantities from their arithmetic mean is less than the sum of the squares of the deviations of the quantities from any number other than the arithmetic mean. The sum (1) consists of $12k$ terms which can be thought of as the sum of 12 groups of $k$ terms each, one group corresponding to each month of the year. The January group, for example, is $k$ times the sum of the squares of the deviations of the January entries about their arithmetic mean, which is $P(0)$. Hence, the January group in (1) is smaller in value than it would be if any other number were substituted in place of $P(0)$. Similar reasoning applies to the other eleven monthly groups in (1). Hence, the sum (1) is smaller in value than it would be if any other periodic function, with the period one year, were used in place of $P(t)$.

TABLE I

| Val. of $t$ | Val. of $f(t)$ | Val. of $t$ | Val. of $f(t)$ | Val. of $t$ | Val. of $f(t)$ | Val. of $t$ | Val. of $f(t)$ |
|---|---|---|---|---|---|---|---|
| 0 | 0.0 | 30 | −7.1 | 60 | 0.0 | 90 | 0.0 |
| 1 | 2.3 | 31 | −9.0 | 61 | 2.1 | 91 | −2.1 |
| 2 | 4.3 | 32 | −10.4 | 62 | 4.0 | 92 | −4.0 |
| 3 | 5.8 | 33 | −11.2 | 63 | 5.4 | 93 | −5.4 |
| 4 | 6.7 | 34 | −11.4 | 64 | 6.2 | 94 | −6.2 |
| 5 | 7.1 | 35 | −10.9 | 65 | 6.5 | 95 | −6.5 |
| 6 | 7.1 | 36 | −10.0 | 66 | 6.5 | 96 | −6.5 |
| 7 | 7.0 | 37 | −8.9 | 67 | 6.4 | 97 | −6.4 |
| 8 | 6.9 | 38 | −7.9 | 68 | 6.4 | 98 | −6.4 |
| 9 | 7.2 | 39 | −7.2 | 69 | 6.9 | 99 | −6.9 |
| 10 | 7.9 | 40 | −6.9 | 70 | 7.8 | 100 | −7.8 |
| 11 | 8.9 | 41 | −7.0 | 71 | 9.0 | 101 | −9.0 |
| 12 | 10.0 | 42 | −7.1 | 72 | 10.5 | 102 | −10.5 |
| 13 | 10.9 | 43 | −7.1 | 73 | 11.8 | 103 | −11.8 |
| 14 | 11.4 | 44 | −6.7 | 74 | 12.7 | 104 | −12.7 |
| 15 | 11.2 | 45 | −5.8 | 75 | 13.0 | 105 | −13.0 |
| 16 | 10.4 | 46 | −4.3 | 76 | 12.7 | 106 | −12.7 |
| 17 | 9.0 | 47 | −2.3 | 77 | 11.8 | 107 | −11.8 |
| 18 | 7.1 | 48 | 0.0 | 78 | 10.5 | 108 | −10.5 |
| 19 | 5.1 | 49 | 1.0 | 79 | 9.0 | 109 | −9.0 |
| 20 | 3.3 | 50 | 1.7 | 80 | 7.8 | 110 | −7.8 |
| 21 | 1.8 | 51 | 2.0 | 81 | 6.9 | 111 | −6.9 |
| 22 | 0.9 | 52 | 1.7 | 82 | 6.4 | 112 | −6.4 |
| 23 | 0.3 | 53 | 1.0 | 83 | 6.4 | 113 | −6.4 |
| 24 | 0.0 | 54 | 0.0 | 84 | 6.5 | 114 | −6.5 |
| 25 | −0.3 | 55 | −1.0 | 85 | 6.5 | 115 | −6.5 |
| 26 | −0.8 | 56 | −1.7 | 86 | 6.2 | 116 | −6.2 |
| 27 | −1.8 | 57 | −2.0 | 87 | 5.4 | 117 | −5.4 |
| 28 | −3.3 | 58 | −1.7 | 88 | 4.0 | 118 | −4.0 |
| 29 | −5.1 | 59 | −1.0 | 89 | 2.1 | 119 | −2.1 |

Let us apply the method of monthly means to an example arranged so as to forestall a certain objection which might be raised against the process. Let the values of our data $f(t)$ be as given in Table I, where $k=10$. The data have already been corrected for secular trend. The monthly means are found to be:

| Jan. | Feb. | March | April | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0 | 1.0 | 1.7 | 2.0 | 1.7 | 1.0 | 0.0 | −1.0 | −1.7 | −2.0 | −1.7 | −1.0 |

In this case the function $P(t)$ which we determine as representing the seasonal variation has the monthly values listed in the table. The standard deviation of the residual function $f(t)-P(t)$ is found to be approximately 7. At first thought, one might consider this large value as an indication that our periodic function $P(t)$ was a poor approximation to the true seasonal variation. As a matter of fact, our function $P(t)$ in this case is *exactly equal* to the true seasonal variation, for $f(t)$ was computed from the following formulas:

$$f(t)=2\sin\left(\frac{t}{12}.360^\circ\right)+10\sin\left(\frac{t}{48}.360^\circ\right),\quad \textit{from } t=0 \textit{ to } t=48,$$

$$f(t)=2\sin(t.30^\circ),\quad \textit{from } t=48 \textit{ to } t=60,$$

$$f(t)=2\sin(t.30^\circ)+11\sin\left(\frac{t}{60}.360^\circ\right),\quad \textit{from } t=60 \textit{ to } t=120.$$

In other words, the $f(t)$ we are working with is the result of superimposing a varying long term oscillation on the seasonal variation given by $2\sin(t.30^\circ)$. Evidently, this problem shows that the size of the standard deviation of $f(t)-P(t)$ cannot be taken as a criterion of the applicability of the method.

The question naturally arises as to what is a proper criterion of applicability. The following theorem furnishes us with a theoretical answer:

*Theorem* (3). *The method of monthly means gives us the actual monthly values of the seasonal variation in case* $f(t)$ *is made up of the following component parts:*

(A) *A seasonal variation, strictly periodic throughout the period of years under consideration.*

(B) *A long term variation which consists of certain independent pieces, each extending over a whole number of years, where each piece represents a whole number of complete oscillations of a corresponding periodic function whose period is an integral number* (*two or greater*) *of years.*

(C) *A second, a third, etc., long-term variation having the characteristics specified in* (B).

The language of (A) and (B) is geometrical in nature, each component of $f(t)$ being thought of as a curve in the $(y, t)$ plane. It is desired that a certain implicit agreement be understood in the statement of Theorem (3). As a consequence of the theory of Fourier series, it is known that a periodic function with the period 5 years, for example, may have component parts with the respective periods $\frac{1}{2}$ of 5 years, $\frac{1}{3}$ of 5 years, $\frac{1}{4}$ of 5 years, $\frac{1}{5}$ of 5 years, or 1 year, $\frac{1}{6}$ of 5 years, etc. The agreement in our case is that the periodic functions referred to in (B) *have no component parts of period one year.* If the long-term variations originally had any one-year components, we are assuming that these were the same for all the variations and that this constant one-year oscillation was then thrown in under the variation mentioned in (A).

An example in which the conditions of Theorem (3) are satisfied would be given, for instance, by a function $f(t)$ defined for 17 years, consisting of

1. A seasonal variation.
2. A long-term variation which
   - (a) for the first four years consists of two complete cycles of a periodic function with period two years,
   - (b) for the next three years consists of one cycle of a periodic function whose period is three years,
   - (c) for the next ten years consists of two complete cycles of a periodic function whose period is five years.
3. A second long-term variation which
   - (a) for the first five years consists of one cycle of a periodic function whose period is five years,
   - (b) for the next twelve years consists of four cycles of a periodic function whose period is three years.

A certain fundamental property of sines and cosines[1] makes Theorem (3) obvious to one familiar with the theory of Fourier series. Consider the particular function cos $(t\ .15^\circ)$, which has two years as its period of oscillation. Let $h$ be *any* positive integer and let $A$ be less than $720^\circ/h$. Then the property referred to is the fact that

$$(3)\ \cos A+\cos(A+b)+\cos(A+2b)+\quad .\quad .\quad .\quad +\cos[A+(h-1)b]=0,$$

where $b=720^\circ/h$. In the averaging process of the method of monthly means we meet consequences of this property which is possessed by all sines and cosines. In determining the mean for any one month, we form a sum of the values of $f(t)$, which, for February, would be

$$(4)\ f(1)+f(1+12)+\quad .\quad .\quad .\quad +f[1+(k-1)12].$$

The effect of the long-term variations (B) and (C) on the sum in (4) is zero, because of equations like (3) which would hold for each piece of (B). The seasonal variation, however, furnishes to (4) exactly $k$ times the value the variation takes on at February in all years. Hence, the monthly mean of $f(t)$ for February is the exact value of the seasonal variation for this month. Similar reasoning applies in the case of the other monthly means, so that Theorem (3) is true.

The statements of Theorems (2) and (3) justify us in applying the method of monthly means in the analysis of data which are affected by the business cycle. In such cases, it is true, the assumptions of Theorem (3) are not exactly satisfied. Nevertheless, there is enough similarity between the conditions of Theorem (3) and the actual conditions affecting the economic data to give us confidence in the results obtained by taking monthly means. Moreover, we always have the unquestionable truth of Theorem (2) as a foundation for our belief. The ultimate test of any method in statistics is, of course, the degree of success it attains in actual practice. This test has not as yet been applied to any great extent in the case of the present method, but it is hoped that its simplicity and ease of application will permit such tests in the future. One application to a set of data is treated in the next part of this paper in connection with a comparison of the method used by Persons and that of monthly means.

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[1] Bôcher, *Annals of Mathematics*, Second Series, Vol. 7 (1906), p. 135, Formula (63).

### 3. COMPARISON OF THE METHOD OF MONTHLY MEANS WITH THAT OF PROFESSOR PERSONS

Consider the data given in Table II. This set of values was computed by means of the following formulas:

$$\begin{aligned} f(t) &= 15+\sin t(30°)+4 \sin t(10°), \quad \textit{from } t=0 \textit{ to } t=36, \\ f(t) &= 15+\sin t(30°)+6 \sin t(10°), \quad \textit{from } t=36 \textit{ to } t=72, \\ f(t) &= 15+\sin t(30°)+2 \sin t(10°), \quad \textit{from } t=72 \textit{ to } t=108. \end{aligned}$$

We have in this case data over 9 years which are the result of compounding the seasonal variation $15+\sin t(30°)$ with the long-term variations given, respectively, by the expressions $4 \sin t(10°)$, $6 \sin t(10°)$, and $2 \sin t(10°)$. The conditions of Theorem (3) of the previous section are satisfied, and, therefore, the method of monthly means leads us to the exact values of the seasonal variation, which are given in the following table:

| Jan. | Feb. | March | April | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 15.00 | 15.50 | 15.87 | 16.00 | 15.87 | 15.50 | 15.00 | 14.50 | 14.13 | 14.00 | 14.13 | 14.50 |

Let us consider obtaining the values of the seasonal variation by Persons' method. First, we are required to compute the ratios of each entry in the $f(t)$ table to the preceding entry. The results of this computation are arranged in monthly columns in Table III. Then, in the resulting series of relatives for each of the twelve months, we pick out the median values, which are listed in Table IV. In using the method under consideration, the assumption now is made that the seasonal variation causes, in the average, each February value to be 1.018 (Table IV) times the preceding January value, each March value to be 1.016 times the preceding February value, etc. It is not our present purpose to consider the non-mathematical arguments in justification of this assumption. However, it must be admitted that the assumption appears to be sensible and would be very acceptable if no logically-founded method were available and if the results to be found below were not on hand as contrary evidence. Instead of considering an argument, let us compare the results of this method with the actual values of the seasonal variation which should be obtained in the present instance.

TABLE II

TABULATION OF $f(t)$ BY MONTHS

| Year | Jan. | Feb. | March | April | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1st........ | 15.000 | 16.196 | 17.234 | 18.000 | 18.438 | 18.564 | 18.464 | 18.260 | 18.074 | 18.000 | 18.074 | 18.260 |
| 2d......... | 18.464 | 18.564 | 18.438 | 18.000 | 17.234 | 16.196 | 15.000 | 13.804 | 12.766 | 12.000 | 11.562 | 11.436 |
| 3d......... | 11.536 | 11.740 | 11.926 | 12.000 | 11.926 | 11.740 | 11.536 | 11.436 | 11.562 | 12.000 | 12.766 | 13.804 |
| 4th........ | 15.000 | 16.544 | 17.918 | 19.000 | 19.724 | 20.096 | 20.196 | 20.140 | 20.044 | 20.000 | 20.044 | 20.140 |
| 5th........ | 20.196 | 20.096 | 19.724 | 19.000 | 17.918 | 16.544 | 15.000 | 13.456 | 12.082 | 11.000 | 10.276 | 9.904 |
| 6th........ | 9.804 | 9.860 | 9.956 | 10.000 | 9.956 | 9.860 | 9.804 | 9.904 | 10.276 | 11.000 | 12.082 | 13.456 |
| 7th........ | 15.000 | 15.848 | 16.550 | 17.000 | 17.152 | 17.032 | 16.732 | 16.380 | 16.104 | 16.000 | 16.104 | 16.380 |
| 8th........ | 16.732 | 17.032 | 17.152 | 17.000 | 16.550 | 15.848 | 15.000 | 14.152 | 13.450 | 13.000 | 12.848 | 12.968 |
| 9th........ | 13.268 | 13.620 | 13.896 | 14.000 | 13.896 | 13.620 | 13.268 | 12.968 | 12.848 | 13.000 | 13.450 | 14.152 |

TABLE III

TABULATION OF RELATIVES BY MONTHS

| Year | Jan. | Feb. | March | April | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1st......... | 1.060[1] | 1.800 | 1.064 | 1.045 | 1.024 | 1.006 | .995 | .989 | .990 | .996 | 1.004 | 1.010 |
| 2d......... | 1.011 | 1.005 | .994 | .976 | .957 | .940 | .926 | .920 | .925 | .940 | .963 | .990 |
| 3d......... | 1.009 | 1.017 | 1.016 | 1.006 | .994 | .984 | .983 | .991 | 1.010 | 1.038 | 1.064 | 1.081 |
| 4th........ | 1.087 | 1.103 | 1.083 | 1.060 | 1.038 | 1.019 | 1.005 | .997 | .995 | .998 | 1.002 | 1.005 |
| 5th........ | 1.003 | .995 | .981 | .963 | .943 | .923 | .907 | .897 | .897 | .910 | .935 | .963 |
| 6th........ | .990 | 1.006 | 1.010 | 1.004 | .996 | .990 | .994 | 1.010 | 1.038 | 1.070 | 1.098 | 1.114 |
| 7th........ | 1.114 | 1.057 | 1.044 | 1.027 | 1.009 | .993 | .982 | .979 | .983 | .994 | 1.006 | 1.017 |
| 8th........ | 1.021 | 1.018 | 1.007 | .991 | .974 | .958 | .946 | .943 | .951 | .966 | .989 | 1.009 |
| 9th........ | 1.023 | 1.026 | 1.021 | 1.007 | .993 | .980 | .974 | .977 | .991 | 1.011 | 1.035 | 1.052 |

[1] January, 10th year.

From the monthly medians of the link relatives listed in Table IV we obtain[1] a corresponding series of relatives on January as a base. For example, the March entry is found by computing (1.018) (1.016) = 1.034, the April value is (1.006) (1.034) = 1.040, etc., as given in Table IV. By this method we obtain for January itself the value (1.021) (.978) = .999, instead of 1.000. This discrepancy[1] is spread over the whole year, giving the final adjusted values found in Table IV. For purposes of comparison the true values of the monthly relatives of the seasonal variation have been computed on January as a base and are listed in Table IV.

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[1] Persons, *loc. cit.*, p. 31.

To find actual numerical values of the seasonal variation from the final adjusted relatives obtained by Persons' method, we compute the mean of all the entries in the original Table II, which is found to be 15. Then we multiply in succession by the monthly relatives. The results of this computation are given in Table IV, with the true values of the seasonal variation listed simultaneously for purposes of comparison. The true monthly increments, or decrements, of the seasonal variation and those of the computed variation are likewise given in Table IV.

TABLE IV

| Month | Medians of relatives | Medians on January as base | Medians adjusted | Actual monthly relatives on January as base | Persons' seasonal variation | Actual seasonal variation | Persons' monthly increment | Actual monthly increment |
|---|---|---|---|---|---|---|---|---|
| January...... | 1.021 | .999 | 1.000 | 1.000 | 15.00 | 15.00 | .31 | .50 |
| February..... | 1.018 | 1.018 | 1.018 | 1.033 | 15.27 | 15.50 | .27 | .50 |
| March....... | 1.016 | 1.034 | 1.034 | 1.058 | 15.52 | 15.87 | .25 | .37 |
| April........ | 1.006 | 1.040 | 1.041 | 1.067 | 15.61 | 16.00 | .09 | .13 |
| May........ | .994 | 1.034 | 1.035 | 1.058 | 15.52 | 15.87 | −.09 | −.13 |
| June........ | .984 | 1.018 | 1.018 | 1.033 | 15.27 | 15.50 | −.25 | −.37 |
| July......... | .982 | .999 | 1.000 | 1.000 | 15.00 | 15.00 | −.27 | −.50 |
| August...... | .979 | .978 | .979 | .967 | 14.69 | 14.59 | −.31 | −.50 |
| September.... | .990 | .969 | .969 | .942 | 14.54 | 14.13 | −.15 | −.37 |
| October...... | .996 | .965 | .966 | .933 | 14.48 | 14.00 | −.06 | −.13 |
| November.... | 1.004 | .969 | .970 | .942 | 14.53 | 14.13 | .05 | .13 |
| December.... | 1.010 | .978 | .979 | .967 | 14.69 | 14.50 | .16 | .37 |

The conclusions to be drawn from the above problem are obvious. By Persons' method we are led through the computation of 108 relatives, the determination of twelve medians, the reduction of these medians to January as a base, the adjustment of these final values to distribute a certain discrepancy over the whole year, and then to the transfer from these adjusted values to actual numerical values of the seasonal variation. Finally, we discover that the error in the monthly decrements or increments is generally about 50 per cent. On the other hand, the method of monthly means leads to the correct numerical values of the seasonal variation after the easy computation of twelve monthly means.

The actual statistical series in which we search for a seasonal variation may differ from the simple case we have treated above, but they differ in that they are much more complicated. If Persons' method does not yield the correct results in a simple case, we must logically consider that its applicability in a complicated instance is open to question.

# SOME RESULTS OF THE 1920 POPULATION CENSUS [1]

By Joseph A. Hill

The first of the results to be arrived at and announced in the process of tabulating and publishing the census data is the total population. The count of population begins as soon as the first schedules have been received, being a hand-count of names; and thus the total population is one result, and the only important one, arrived at without the use of electrical tabulating machinery.

The taking of the Fourteenth Census began on January 2, 1920, on which cold morning 90,000 enumerators started out from their homes with portfolios of schedules under their arms and fountain pens in their pockets, being thus armed and equipped and having been duly instructed to take the census of the United States.

The bulk of the schedules had been received in Washington by the end of March, and most of the remainder by the end of April; but schedules continued to come in all through the summer months, and the hand-count of names was not completed until October 7, 1920, on which date the more or less interested world learned that the population of the United States, not including outlying possessions, was a little over 105,000,000. The final figure, as announced later, was 105,710,620. Population since the preceding census had increased 14.9 per cent. This is the lowest rate of decennial increase recorded in the history of the nation and represents a marked retardation of growth as compared even with the preceding decade, when the increase was 21 per cent. Although this is not the kind of record in which the American people usually take pride, I doubt whether there is any good reason to regret, and whether anybody did in fact regret, this retardation in our rate of growth. It may be of interest to consider where we should be now if our rate of growth had never been retarded.

During the first seven decades of our history as a nation, population increased with remarkable uniformity at a rate deviating but little from 35 per cent, the actual rates for the successive decades being as follows: 35.1, 36.4, 33.1, 33.5, 32.7, 35.9, 35.6. This brings us down to 1860, just before the Civil War. If the country had kept on growing at the rate of 35 per cent per decade we should have had in 1920 a population of 190,000,000. That numerically is about where we should be now if our rate of growth had never been retarded. By the end of the present century, if the same rate of growth were to continue, we should be past the two billion mark. I have not carried this computation any farther, but no less an authority than Darwin, whose mathematics I judge it unnecessary to verify, writing in the decade following the census of 1860, pointed out that the population of the United States, if it kept on doubling every twenty-five years as it was then doing, would in 657 years cover "the whole terraqueous globe so thickly that four men would have to stand on each square yard of surface." That brings us to about the year 2500, and it is hardly worth while to go any farther—we may stop with four to a square yard.

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[1] Read at the Eighty-third Annual Meeting of the American Statistical Association at Pittsburgh, Pa., December, 1921.

Darwin, needless to say, was not predicting. He introduced this statement in his *Descent of Man* simply as indicating that a rate of growth such as that in the United States, the highest rate probably ever experienced for as long a period by any considerable population in the history of mankind, was necessarily bound to be checked in some way sooner or later. And in fact the first check came at the period in which he was writing; for the next census, that of 1870, recorded a marked reduction in the rate of growth. The decennial rate of increase dropped to 26.6 per cent, and it stayed there approximately for the next two decades, being 26 from 1870 to 1880, and 25.5 from 1880 to 1890. These rates, it should be noted, are based on corrected figures for the 1870 census. It was in reference to this period that Francis A. Walker promulgated his theory of a check to natural increase of native population being caused by the great influx of foreigners, this accession of foreigners constituting, as he phrased it, "a shock to the principle of population on the part of the native population." With 1890 the period of 26 per cent increase came to an end. There was another retardation of growth. The percentage fell to 20.7 between 1890 and 1900, followed by a rate of 21 between 1900 and 1910.

Noting that the United States has passed through a period of 35 per cent increase lasting 70 years, followed by a period of 26 per cent increase lasting 30 years and then by a period of 21 per cent increase lasting 20 years, one wonders whether the decade which has just been completed and which shows an increase of 14.9 per cent inaugurates a 15 per cent period. I should not be surprised if it did. At any rate, considering the evident intention of Congress to restrict immigration or possibly to stop it altogether—an intention which, I think, public sentiment supports—and considering also the tendency toward smaller families and a lower birth rate on the part of the native population, I will chance the prediction that we are not very soon coming back to the 21 per cent increase of the preceding period.

It is not difficult to account for the check to population growth in the decade just completed. If the population of the United States between 1910 and 1920 had increased at the same rate that it did between 1900 and 1910, that is, if there had been no retardation of growth in the later decade as compared with the earlier, we should have had in 1920 a population of about 111,300,000 instead of 105,700,000. Therefore we are, so to speak, short about six million. This shortage was due largely to the check to immigration consequent upon the outbreak of the European War. Between 1900 and 1910 over 8,000,000 immigrants arrived in the United States. Between 1910 and 1920 the number was about 5,000,000, which was hardly more than sufficient to make good the losses from emigration and from deaths among immigrants.

Consequently the percentage of increase for the foreign-born white fell off from 30.7 between 1900 to 1910 to 2.8 between 1910 and 1920. If this element of our population had maintained the same rate of growth in the later decade that it had in the earlier, it would have increased by over 4,000,000, while in fact it increased only 367,000. That difference largely accounts for the retardation of our population growth. But it may be noted that the percentage of increase fell off likewise, though not to anything like the same degree, in the case of each of the two other main components of the population, namely, the native white and the negro. In case of the former, the native white, the percentage of increase declined from 20.8 between 1900 and 1910 to 18.6 between 1910 and 1920, and in the case of the negro from 11.2 in the earlier decade to 6.5 in the later. A decline in the percentage of increase for the native white was to be anticipated if for no other reason than because the growth of the native white is promoted by the birth of native children in immigrant families, and of course this source of increase begins to dry up as soon as immigration stops or is checked. But the growth of negro population is not affected to any appreciable degree by immigration, either directly or indirectly, and the check to its growth, which is one of the surprising results of the census, can mean only one thing—a falling-off in natural increase, indicating either a decreasing birth rate or an increasing death rate, or both.

Turning now to another subject, the growth of urban population, we may note that the Fourteenth Census records the fact that the percentage urban in our population has now crossed the halfway mark—halfway, that is, between no urban and all urban—the exact percentage urban in 1920 being 51.4 as compared with 45.8 in 1910. Therefore, a majority of the people in the United States are now city residents according to the official census definition of the term "city," which signifies any incorporated community having a population of 2,500 or more.

Going back only forty years to 1880, we find that the percentage of city dwellers at that time was 28.6, a percentage which increased to 35.4 in 1890, to 40 in 1900, to 45.8 in 1910, and, as just stated, to 51.4 in 1920, thus advancing about 5 points during each of the last three decades, so that the increase from 1910 to 1920 on the face of it does seem exceptional. This statement, however, requires, I think, some qualification. There is, I believe, a difference between the last and the preceding decades; for, looking upon the increase in the percentage urban as being, mathematically speaking, a function of population growth—as bearing, that is, a relation to population growth such that it tends to vary directly as the rate of total population growth varies, mounting more rapidly when population is increasing rapidly and more slowly when it is increasing slowly—we may note as significant the fact that an increase of 14.9 per cent in the total population between 1910 and 1920 produced as great an advance in the percentage urban as was produced by an increase of 21 per cent in the total population growth between 1900 and 1910 and 20.7 per cent between 1890 and 1900. Thus the slowing up of population growth between 1910 and 1920 did not retard the increase in the percentage urban, and considered in that relation the increase was exceptionally large.

The increase in the percentage urban implies, of course, that the urban population increased more rapidly than the rural. The contrast between the rates of growth for the two classes of population was in fact very pronounced. Between 1910 and 1920 the urban population increased from 42,166,120 to 54,304,603, an increase of 26.4 per cent, while the rural increased from 49,806,146 to 51,406,017, an increase of 3.2 per cent. Both rates of increase were smaller than in the preceding decade, when the urban population increased 38.8 per cent and the rural 9.2.

The rural population as defined by the census includes numerous small incorporated villages, boroughs, and towns having fewer than 2,500 inhabitants. The rural population outside these villages, which might be called truly rural, increased only about 2 per cent between 1910 and 1920, being 41,636,997 in 1910 and 42,436,776 in 1920, an absolute increase of about 800,000 as compared with an increase of 12,000,000 in the urban population.

The country village, if it grows, becomes some day a small city. It crosses the 2,500 line and thus grows out of its class just as inevitably as the boy attains the stature of a man. Thus the urban population is constantly being recruited and the rural population depleted by these country villages which pass over the border line that separates town from country as defined by the census. In this way the urban population grows by accretion at the expense of the rural population as well as by expansion or natural increase and immigration. In this respect it may be said that the urban population has a sort of unfair advantage over the rural in the rivalry of growth. The latter is handicapped in the race. If it grows too ambitiously it grows away from itself.

Between 1910 and 1920, 471 rural villages or towns became small cities. Each of these as it crossed the line to the enemy's territory took with it 2,500 people, and thus altogether they added 1,177,500 to the urban population of the United States and took away that number from the rural. They also added to the urban population whatever growth they had after they crossed the line up to the time the 1920 census was taken. This growth of urban population by accretion being, however, only a little over 1,000,000, the growth by expansion resulting from natural increase and migration must have been nearly 11,000,000. For the purpose of a rough estimate or approximation, I believe we could take 10 per cent as representing the rate of natural increase in city population, and on that basis we may resolve the total increase of over 12,000,000 in urban population as follows: 1,175,000 growth by accretion; 4,500,000 natural increase within the city population, or excess of births over deaths; 6,500,000 migration from without. It may be remarked, moreover, that in view of the check to the foreign immigration to the United States the migration which contributed to the growth of cities in this last decade must have been largely domestic migration, that is, migration within the United States from country to city. This domestic cityward migration may be estimated as between 3,000,000 and 4,000,000.

An increase in the percentage urban—though sometimes deplored or even featured sensationally as an alarming condition—is, I believe, inevitable in a settled and growing country, although it may not of course be inevitable to the degree to which it actually takes place. But where the agricultural land has been practically all taken up, if population is still to increase that increase must almost inevitably be accompanied by, or result in, an increase in the percentage urban. It is a tendency which could be held in check or counteracted only by a resort to more intensive methods of agriculture or by the establishment of rural industries of such kind that they could thrive and still remain rural, and not result in the creation of rural villages that immediately start to become small cities.

Any picture of growing rural communities on their way to become small cities needs, however, a counterpart, or else needs to be redrawn if it is to have the due proportion of light and shade required to portray actual conditions. For there are large areas in the United States in which population is decreasing, or, at any rate, in which population decreased during the last ten years, and these areas consist mainly of rural districts including many small incorporated places—villages, boroughs, or cities, so-called. On one of the census county maps the areas of decreasing population are distinguished by patches of white, the rest of the map being shaded. These white areas appear in every state with the exception of Connecticut and Arizona; and they would appear in Connecticut if the areas were defined by township instead of by county lines, and probably also in Arizona if the counties were not so large. On this map 78.2 per cent of the total area of Missouri is white, 77.9 per cent of the little state of Delaware, 73 per cent of Nevada, 68.4 per cent of Indiana, 61.2 per cent of New York state, and 60 per cent of Vermont.

Thus almost every state may be divided into two contrasted groups of counties, the one populous and increasing in population, the other thinly populated and decreasing. It is a case where the rich in population are growing richer and the poor poorer.

In Missouri, for instance, where the population as a whole increased 3.4 per cent between 1910 and 1920, there were 26 counties, containing the principal cities of the state, in which it increased in the aggregate 14.4 per cent, while in the rest of the state it decreased 7.1 per cent. As another illustration take New York state, where the increase of 14 per cent in the total population of the state was the net result of an increase of 17.7 per cent in the population of 28 counties and a decrease of 6.2 per cent in the population of 34 counties.

In the United States as a whole and in nearly every individual state the area of decreasing population is larger than it was 10 years ago. Among the states there are only two or three exceptions, of which Iowa is the most notable. In that state the area of decreasing population, which, as shown by the census of 1910, covered 70 per cent of the total area of the state, has now shrunk to only 26 per cent of the total. Thus Iowa has come back to a certain extent. In Wisconsin and Minnesota, also in Utah, there was a similar though less marked change. But in most states, as well as in the country as a whole, the area of decreasing population, while fluctuating in outline, advancing at one point and receding at another, has broadened in extent, embracing a greater number of counties and a much larger territory than it did ten years ago. In the United States as a whole the number of counties showing a decreasing population increased from 769 in 1910 to 1,082 in 1920, and the area embraced within such counties increased from 472,462 square miles to 908,803, and from 15.9 per cent of the total area of the United States to 30.6 per cent.

Naturally the check to immigration, or rather its practical cessation after the outbreak of the European War, and the marked retardation in the natural increase of negro population have brought about a change in the composition of the population of the United States as regards race and nativity. The percentage foreign-born—or, strictly speaking, the percentage of foreign-born whites—declined from 14.5 in 1910 to 13.0 in 1920, and the percentage negro declined from 10.7 to 9.9, while the percentage native white increased, being 74.4 in 1910 and 76.7 in 1920. Thus the census of 1920 as compared with 1910 shows a smaller percentage of negroes and of immigrants in our total population and a larger percentage of native whites. It might be said, therefore, that as regards the foreign-born element in our population the census indicates that the problem of assimilation has become slightly less formidable, although I am not so sure that it can be said that reduction in the percentage of negroes has made the race problem any less acute.

The percentages given above are very commonly cited and accepted as indicating the relative strength and importance of the foreign-born element. As a matter of fact, however, they are inadequate for that purpose, or possibly misleading, owing to the fact that the foreign-born population consists mostly of adults. There are comparatively few children among the arriving immigrants. Many children may be born to them after they come here, but these the census properly classifies as natives, the distinction between native and foreign being a line of statistical cleavage which cuts in between parents and children within the same family.

We obtain a more significant measure of the relative importance of the immigrants if we consider the percentage which they form of the adult population or, taking a figure which is conveniently accessible in the census reports, the percentage which they form of the total male population 21 years of age and over. It is a percentage which would be startling if we had not become familiar with it, or if it were announced for the first time in the history of census-taking. In 1910—to take first the earlier and more sensational percentage—24.6 per cent, or practically one fourth of the male population 21 years of age and over, consisted of immigrants. The percentage has now declined to 22.1, which is still over one fifth of the total. Of course, much higher percentages are reported in certain sections of the country. In the Middle Atlantic States (New York, New Jersey, and Pennsylvania) 35.4 per cent of the male population 21 years of age and over is foreign-born: in the New England States, 38.2 per cent; in Massachusetts and in Boston, 46 per cent; and in New York City, 53.4 per cent.

I shall advert only briefly to the change in the age composition of the population as revealed by the census. Measured by percentages such changes seem slight, but yet they may be very significant. The proportion of children under 5 years of age in the total population has decreased from 11.6 per cent in 1910 to 10.9 in 1920; the proportion of older children from 5 to 14 increased very slightly, or from 20.5 per cent in 1910 to 20.9 per cent in 1920; but the proportion of the population between 15 and 35, comprising the period of youth and the most active and vigorous years of adult life, or of early manhood and womanhood, decreased from 36.2 per cent of the total population in 1910 to 33.9 per cent in 1920. For every age period above 35 the percentage has increased. The percentage between 35 and 45 increased from 12.7 to 13.4; between 45 and 65, from 14.6 to 16.1; 65 and over, from 4.3 to 4.7. In the aggregate the percentage of the population 35 years of age and over increased from 27 to 34.4, while the percentage below that age correspondingly fell off from 73 to 65.6.

The age composition of the population is affected by changes in the birth rate, in immigration, and in the death rate for the different age periods; and it is not easy to determine to what extent these various diverse factors have been operative in producing the change of age composition which has actually taken place. A decrease in the proportion of the population in the ages 15 to 35 is a natural result of the check to immigration, as most of the immigrants are within those ages when they arrive in this country. But the influenza epidemic may have played some part in producing this change, since that disease was, I believe, more prevalent and fatal in the period of life between 15 and 35 than in older or younger years. The decrease in the proportion of children probably reflects a decline in the birth rate; but the effects of a declining birth rate upon the proportion of children may be partially disguised or offset by a diminishing infant-mortality rate. A decrease in the proportion of children and adults under the age of 35 involves, of course, of itself an increase in the proportion above 35. At the same time a diminishing death rate in the period of middle age may have been operative as an independent cause resulting in the prolongation of life to older years.

In the negro population the percentage of children under 5 years of age decreased from 12.9 in 1910 to 10.9 in 1920, and the percentage under 10 years of age from 25.6 to 23. Such a change as this indicates a decided decline in the birth rate. In the native white population of native parentage, the percentage of children under 5 declined from 13.2 to 12.6, and the percentage of children under 10 years of age from 25 to 24.5.

In the main the change in the age composition revealed by the census of 1920 as compared with that of 1910 is simply a continuation of a change that has been going on for a long time. Going back only to 1880 we find that 38.1 per cent of the population at that time consisted of children under 15 years of age; now the percentage is 31.7. The percentage above 45 increased during that interval from 16 to 20.8; and the percentage of old people above the age of 65 increased from 3.4 to 4.7. The population in this sense is growing older. Increased longevity would tend to produce this result, and so too would a diminishing birth rate. Probably both causes are operative.

To conclude with a recapitulation: A retardation of population growth; an increase in the percentage urban, more striking, all things considered, than in the preceding decade, and resulting to a greater extent from cityward migration; a marked extension of the area of decreasing population; a decrease in the percentage foreign-born caused by the check to foreign immigration, and in the percentage negro, indicating a declining birth rate for that race; a decrease in the proportion of children and of adults under 35 in the total population and a corresponding increase in the proportion above 35—these are some of the results shown by the Fourteenth Census.

# KINETIC STATISTICS AS AN AID TO PRODUCTION AND DISTRIBUTION

By Walter N. Polakov

Manufacturing concerns, particularly those of considerable size, have for years been in the habit of maintaining statistical departments. It has been generally assumed that statistics of manufacturing activities, compiled by gathering and classifying data, are of assistance to executives in shaping policies or detecting major shortcomings. But it was not until the development of kinetic statistics that the executive found an effective aid for getting things done.

The function of these old statistical interpretations was:

1. To establish relations, existing in the *past,* among numerous factors which have influenced production.
2. To prognosticate *future* probabilities as to volume of business, prices and costs, and the general trend of other influential factors.

The basis for such work was usually found in:

1. Diverse manufacturing and accounting records of the concern itself.
2. Such other outside data as was available and pertinent to the subject studied.

The usefulness of these efforts is commonly limited by the very nature of the undertaking, because:

1. What *has been* in the past is not necessarily an indication of what *will be* in the future under changed conditions; indeed, if it were so, there would be no improvement, no progress, no growth.
2. What has been or what is being done in no way carries the assurance that things are as they *should be;* indeed, so long as there is no gage of perfection, no evaluation of past and present performance can be made, and such an absence of preëstablished aim renders the whole activity a purely accidental character.

These two intrinsic limitations of the traditional *static* statistical method give it a passive character which neither leads nor judges but merely records. Even the very progress thus recorded in rows of figures or curves reflects the chance development and a fatalistic attitude rather than an activity directed by volition toward a definite goal. Specific though limited usefulness of this static method is of course not denied; but its intrinsic limitations are emphasized in contradistinction with the newer method of kinetic statistics, which involves a study of the movement through time toward a set task.

In order to comply with two fundamental characteristics of human nature, namely, the lure of perfection and the relativity of cause and effect in time, any statistical method dealing with any human activity should recognize that (1) the facts in themselves or in relation to each other are of no human interest except when *compared with the desired results*, and (2) the attainment of the desired results is of no human value unless it is *attained within time specified.* To be more explicit: Consumption of 30,000 heat units per kilowatt hour energy produced may mean 95 per cent perfection in one plant and 50 per cent waste in another; to build a house for $10,000 may be economical for the specification, but if it takes ten years to complete the construction, double the expense in six months would be more economical.

*In practice, kinetic statistics are based on one constant scale of time, and the actual accomplishment is invariably compared with a predetermined task to be completed within the given period of time.*

The practical task of controlling production must of necessity begin with measurement and, to be correct, measurements must be made in the proper dimension. It would be a grave blunder to apply a unit of one dimension to an entirely different dimension, or to use a measurement which contains a variable element. We cannot use for measuring human work the units of mechanical power such as foot-pounds or horse-power which embrace only the muscular work of men, even though these expressions contain the time rate, for it would be a confusion of part with the whole. The time rate of man's work is the only measure of production which is of the same dimensionality as the energy causing it, and it is as constant as the solar system itself.

Since time may be spent for different purposes and the amounts of work that can be done in a unit of time may of necessity differ, the scales may be as varied as are human activities themselves; but we cannot conceive human activity without or beyond time.

Time in its relation to our existence is divided into present, past, and future. Hence we have three fundamental managerial problems visualized in three forms of charts: as applied to the present or to current work—Man Record Charts; as referring to work done in the past—Machine Record Charts; and, finally, as projected to future work—Progress Charts, with their schedules laid out on the time scale of future requirements.

During the time devoted to productive work there is a variable amount of work done, as is shown on the Man Record Chart, but this work is performed and directed by men. "To feel the lure of perfec-

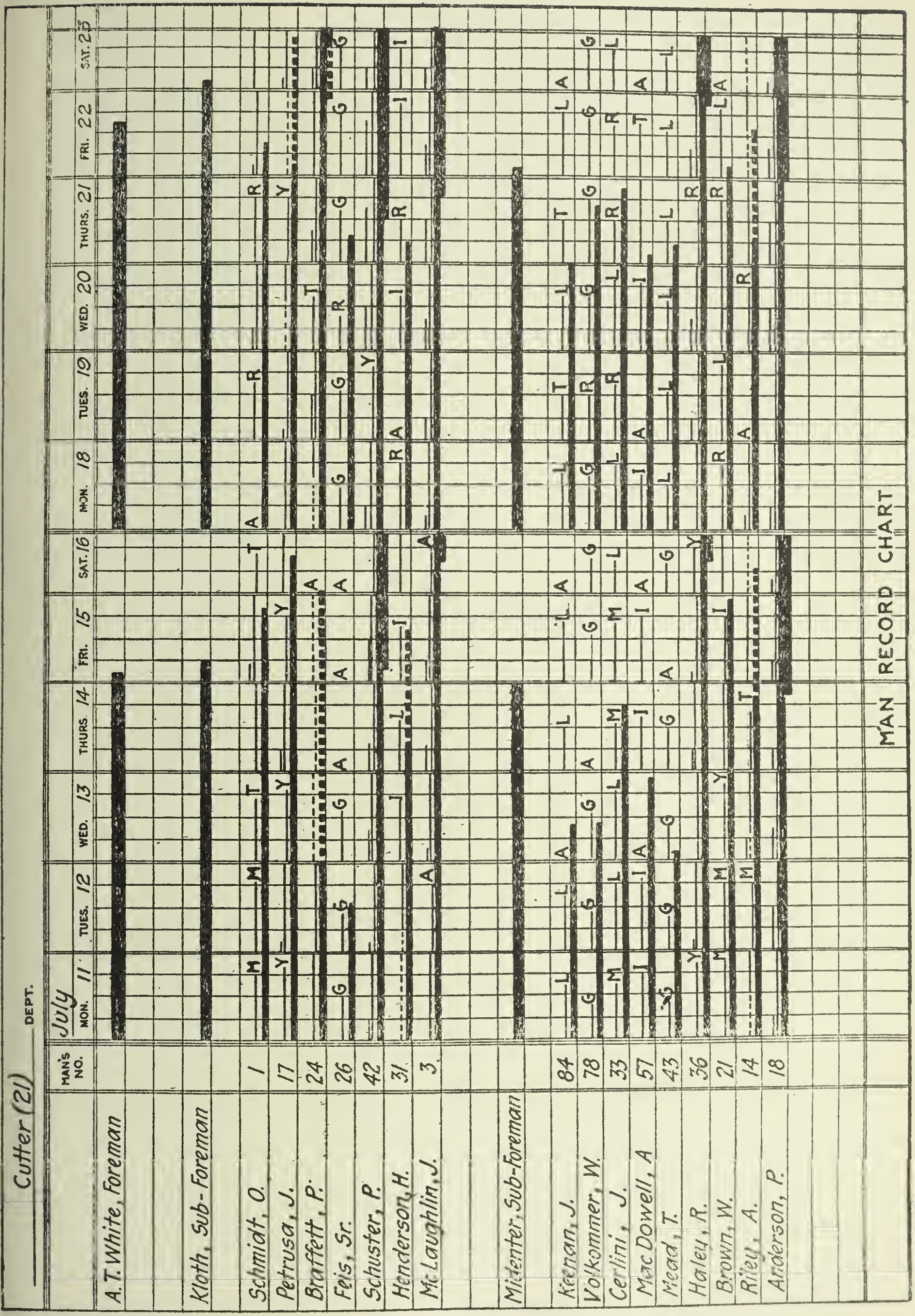


FIGURE 1.—MAN RECORD CHART

Width of daily space represents amount of work that should have been done in a day. Dash lines represent time taken to do work for which there was no time estimate. Solid thin lines represent the proportion of work done in a day, and heavy lines are the summaries. Letter symbols indicate the causes of delay or handicaps: A = absent; G = green operator; I = instructions lacking; L = slow operator; M = material troubles; R = repairs needed; T = tool trouble; V = holiday Y = smaller lot than estimate is based on.

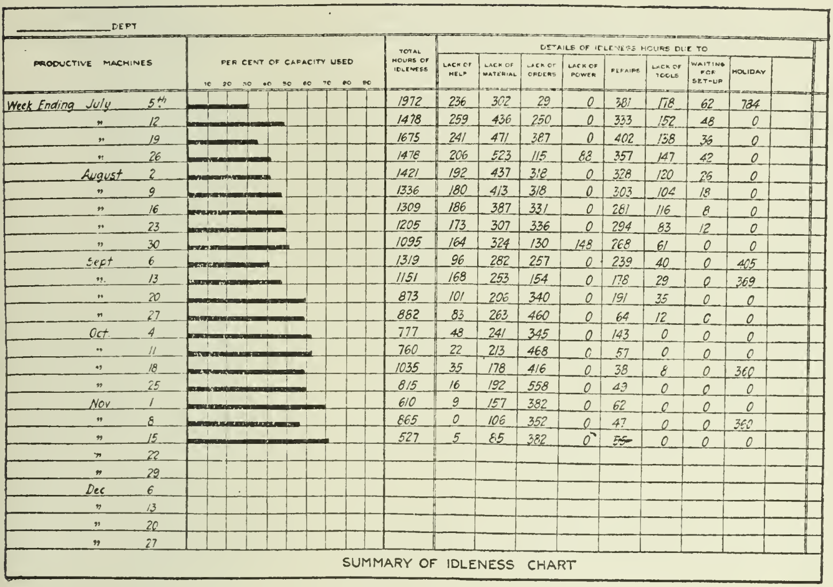
tion," says Professor C. J. Keyser, "in one or more types of excellence, however lowly, is to be human; not to feel it is to be sub-human." And a chart of this kind involves that ideal of service. It shows what is expected to be accomplished within the work time for any occupation, however lowly.

In such a chart this ever-striving impulse of self-expression in service, which throbs in every human being, is given adequate expression and stimulus. It is accomplished by predetermining the ideal, however modest, which is accepted by a man as within his power of attainment. Then, and only then, can the lines of attainment be drawn from day to day to denote the falling short of the aim or the equaling and even surpassing it, as the obstacles of inertia, ignorance, or lack of coördination are overcome by the strongest of all human propensities—the desire to excel oneself. This type of chart can truthfully be called a tool for humanizing industry, for it not only reveals to a man his own dignity and capacity as a creator, but subtly, though persistently, calls for coöperation between the workers with brain and brawn. It tells what each of us and all of us are doing at the present time.

The Machine Record Chart reveals to one who reads between the lines much more than merely the time a certain machine was idle. Its scale is also time, but the time during which a machine remains unproductive has a graver significance than a reminder that "time is money." It means that some one who should have operated it or supervised its operation was not employed, and the time consumed in inventing, developing, and building this machine, which is greater in its productive significance than the time of the operator, is irretrievably lost.

Likewise, the Material Utilization Chart (like that of fuel utilization developed by the author), indicating the waste of material or energy, has a deeper meaning. It shows the extent to which the work of other men in recovering, preparing, and delivering this material or energy has been destroyed. It means that the work of hosts of men has been rendered useless and that their productive time is forever lost. This type of chart gives us the measure of our utilization of the work that has been done before. It proves whether we are worthy of our inheritance from the past.

Lastly, the Progress Chart integrates all elements of work, it sums up the progress made, its acceleration, its retardation, its time rate. Like other charts it brings together the ideal and the fact. Its ideal projects into the future and sets before us the task which we are called upon to perform, no matter how small or how great it may be, whether filling an order in a shop, feeding a nation, or advancing the life and



_____________ DEPT

| PRODUCTIVE MACHINES | PER CENT OF CAPACITY USED<br>10 20 30 40 50 60 70 80 90 | TOTAL HOURS OF IDLENESS | DETAILS OF IDLENESS HOURS DUE TO | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | LACK OF HELP | LACK OF MATERIAL | LACK OF ORDERS | LACK OF POWER | REPAIRS | LACK OF TOOLS | WAITING FOR SET-UP | HOLIDAY |
| Week Ending July 5th | | 1972 | 236 | 302 | 29 | 0 | 381 | 178 | 62 | 784 |
| " 12 | | 1478 | 259 | 436 | 250 | 0 | 333 | 152 | 48 | 0 |
| " 19 | | 1675 | 241 | 471 | 387 | 0 | 402 | 138 | 36 | 0 |
| " 26 | | 1478 | 206 | 523 | 115 | 88 | 357 | 147 | 42 | 0 |
| August 2 | | 1421 | 192 | 437 | 318 | 0 | 328 | 120 | 26 | 0 |
| " 9 | | 1336 | 180 | 413 | 318 | 0 | 303 | 104 | 18 | 0 |
| " 16 | | 1309 | 186 | 387 | 331 | 0 | 281 | 116 | 8 | 0 |
| " 23 | | 1205 | 173 | 307 | 336 | 0 | 294 | 83 | 12 | 0 |
| " 30 | | 1095 | 164 | 324 | 130 | 148 | 268 | 61 | 0 | 0 |
| Sept 6 | | 1319 | 96 | 282 | 257 | 0 | 239 | 40 | 0 | 405 |
| " 13 | | 1151 | 168 | 253 | 154 | 0 | 178 | 29 | 0 | 369 |
| " 20 | | 873 | 101 | 206 | 340 | 0 | 191 | 35 | 0 | 0 |
| " 27 | | 882 | 83 | 263 | 460 | 0 | 64 | 12 | 0 | 0 |
| Oct. 4 | | 777 | 48 | 241 | 345 | 0 | 143 | 0 | 0 | 0 |
| " 11 | | 760 | 22 | 213 | 468 | 0 | 57 | 0 | 0 | 0 |
| " 18 | | 1035 | 35 | 178 | 416 | 0 | 38 | 8 | 0 | 360 |
| " 25 | | 815 | 16 | 192 | 558 | 0 | 49 | 0 | 0 | 0 |
| Nov 1 | | 610 | 9 | 157 | 382 | 0 | 62 | 0 | 0 | 0 |
| " 8 | | 865 | 0 | 106 | 352 | 0 | 47 | 0 | 0 | 360 |
| " 15 | | 527 | 5 | 85 | 382 | 0 | ~~55~~ | 0 | 0 | 0 |
| " 22 | | | | | | | | | | |
| " 29 | | | | | | | | | | |
| Dec 6 | | | | | | | | | | |
| " 13 | | | | | | | | | | |
| " 20 | | | | | | | | | | |
| " 27 | | | | | | | | | | |

SUMMARY OF IDLENESS CHART

FIGURE 2.—MACHINE RECORD CHART: SUMMARY OF IDLENESS

This chart compares the records of twenty succeeding weeks and illustrates the progress made toward removing the causes of idleness due to knowledge of the causes of idleness. The numbers given in tabulation are man-hours lost due to various classified reasons. If an average hourly man rate is $1 and overhead $2, the 1,500 hours of weekly idleness cost the company $4,500 besides loss of profit on goods not produced. Incidentally, the purchasing power is also reduced by $1,500 direct loss of earnings, etc.

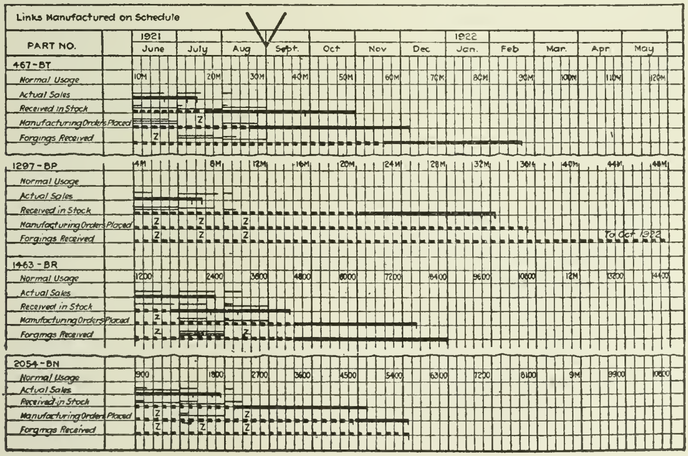


FIGURE 3.—PROGRESS CHART (continuous production)

The normal usage of 10,000 parts per month is compared with sales, production, orders placed, and parts received. Dash lines indicate the work done before June 1 when the chart was started. The chart is entered as of August 31. The figures at the left show amounts scheduled for the month; the figures at the right show the cumulative total to be done to date. All of thesel ines moved forward month by month, and the difference in the lengths of the cumulative lines always showed the parts in stock, the parts on order, and the parts on hand.

happiness of mankind. It calls for a plan and vision of the future. It is based on knowledge of the past, and it reveals our present position.

This time concept in the control of industry, direction of production, and measurement of human work thus stands revealed as the wished-for solution, free from error of confused types and dimensions. It refers all facts to the irreducible and final element of human life—time. But it is true to the human dimension, it is both human and humane; hence it obliterates conflicts between men and management, promotes the fullest exercise of man's creative forces, and places work in its proper relation to life.

An executive of a manufacturing concern which has used charts of this nature for several years recently told of his experience in these unequivocal words:

> I have frequently seen charts bring up an average accomplishment to a standard previously thought impossible and within a comparatively short time justify an intelligent raising of the standard without creating any friction. Charts viewed daily admit of an examination of the entire operation; absence of charts permits an observation of just that proportion of the operation which an executive can keep actual watch over. Without charts an executive is utterly helpless and at the mercy of those on whom he depends for his departmental work. On the other hand, a daily supervision of the charts, with proper action taken on the necessities for action thus disclosed, will automatically insure a proper operating statement. If charts are used the arrival of the operating statement need not be anticipated with alarm.[1]

Similarly, in representing and directing selling efforts, such kinetic charts, if properly introduced with carefully worked-out quotas for each salesman within a certain time, fully comply with the two fundamental requirements, namely, that the actual be compared with the ideal, and that it be measured in terms of time. The results are invariably most stimulating and gratifying.

Finally, activities of national magnitude lend themselves with equal readiness to an efficacious kinetic chart presentation. Predetermined national consumption (demand) of various commodities, when compared within the time specified with actual deliveries (for satisfaction of the demand) on such a chart, readily discloses any maladjustment of distribution, as, for instance, when most needed commodities such as ammonia were hardly brought in at all, and perishable goods (such as bananas) were imported in an appalling excess. Adjustment of such cases and prevention of their repetition are greatly facilitated by the disclosures clearly and immediately made by the use of this method of kinetic statistics.

There is but one more point that need be covered in this paper: The aid rendered by the charts of kinetic statistics is (1) immediate, (2) universal, and (3) does not conflict with any other method, statistical or administrative.

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[1] See Wallace Clark, "Gantt Chart," Ronald Press, N. Y., 1922. Charts reproduced by courtesy of the author.

It is immediate because the data are gathered by men actually engaged in production, and therefore any falling-short of standard spurs them on toward improvement or the elimination of handicaps. *Before* the higher executives have an opportunity to criticize, they are asked to help.

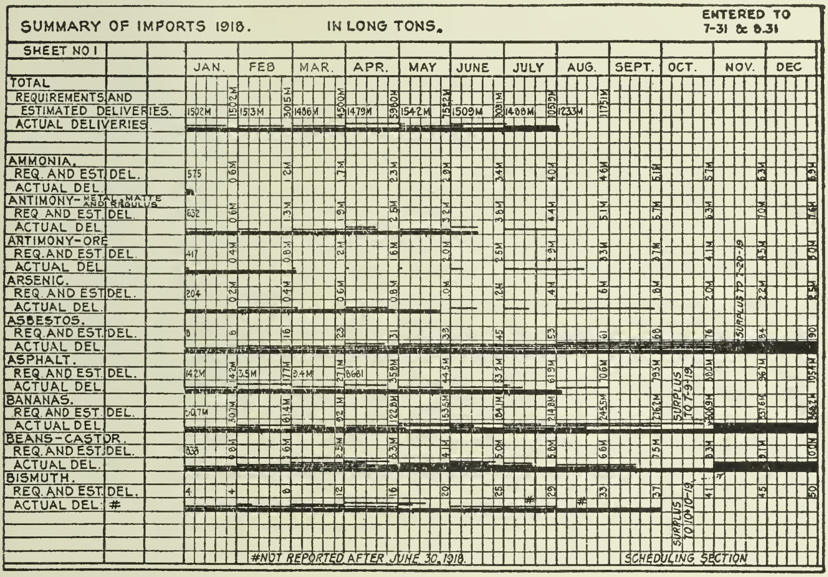

FIGURE 4.—SUMMARY OF IMPORTS: COMPARISON OF REQUIREMENTS WITH ACTUAL DELIVERIES OF COMMODITIES

The thin lines represent actual monthly deliveries drawn to a scale of monthly requirements. The heavy lines indicate cumulative totals. The figures denote monthly (left) and cumulative (right) requirements. Plurality of lines indicate excess of deliveries over the requirements, the length of one month's space = 100 per cent of estimated requirement.

It is universal since it is equally applicable to a small shop, to a great trust, a school, a railroad, or to a problem of national economy.

It does not conflict with any other form or manner of elaborating, combining, and presenting statistical data:—Kinetic charts have a mission quite their own—to tell while the thing is being done whether it is being done well, and if not, why not; and whether it will be done in time, and if not, what steps should be taken to get the thing done.

# WESTERGAARD'S METHOD OF EXPECTED DEATHS AS APPLIED TO THE STUDY OF INFANT MORTALITY

By Robert M. Woodbury, *Children's Bureau*

A characteristic of infant mortality data, as well as of many other kinds of economic and social material, is that many and varied causes are at work to produce the given results. A prime requisite in a method for analyzing such data, therefore, is that it shall permit of separating out and determining the influence of each factor when other conditions or factors are held constant. This requisite is possessed by Professor Westergaard's method of expected deaths used in conjunction with multiple classification. The purpose of this paper is to present to American readers the mode of applying that method to infant mortality data, and incidentally to give certain partial results of applying it to data gathered by the United States Children's Bureau. It may be remarked in passing that the method may be applied as effectively to many other problems.

Among the causal factors with which we are concerned in analyzing infant mortality data the following may be included, at least tentatively: sex, age, single or plural birth, type of feeding, care of mother during pregnancy, mother's employment, care of infant during first year of life, economic status of the family, age of mother, order of birth, interval from the preceding birth, pregnancy of the mother following the the birth, nationality of the mother, death of the mother, housing conditions, and illegitimacy.

In relation to each factor three questions are always pertinent—the questions of relative mortality, of prevalence, and of the contribution which the factor makes to the general result. Thus, with respect to single and plural births, the first question is whether twins and triplets have a greater mortality than single births; the second, what proportion of the total births are plural; and the third, do twins and triplets contribute a large quota to the infant deaths? The answer to the last question obviously depends upon the answers to the other two. The first and third questions are often confused, as in the inquiry: Is the mother's employment an important factor in infant mortality? This is capable of two interpretations, one—of greater importance in an analysis of causes—relating to relative mortality, *i. e.*, whether infants whose mothers are employed are subject to a higher rate of mortality than infants whose mothers are not employed, and the other relating to the amount of contribution to the total mortality, *i. e.*, whether any excess mortality among infants of employed mothers in connection with a large or small prevalence of mothers' employment results in an important contribution to infant mortality. This question is of secondary importance since the contribution is the resultant of two primary elements. The method of analysis should distinguish between these primary and secondary elements in the problem.

The conclusions reached with regard to the relative mortality associated with each factor, so far as the factor itself is conceived to represent a true causal element, are tentative; they are subject to qualification if intercorrelations with other factors are present. It is therefore important to study the intercorrelations of the several factors. These intercorrelations have two aspects: first, whether the presence of one factor is associated or correlated with the presence of another, and second, whether the relative mortality exhibited by the first factor varies as it is associated with the second. The amount of qualification of the tentative conclusion is dependent upon the closeness of correlation between the factors, the importance of the associated factors, and the degree of excess mortality connected with them. So far as no such intercorrelations are present, the tentative conclusion remains unmodified.

These principles may be apprehended more clearly in illustrations. An analysis of a group of births by sex shows (1) that males have a slight preponderance over females, and (2) that the mortality rate among males in the first year of life is slightly higher than that among females. To determine whether this tentative conclusion (2) requires qualification, the prevalence of male births must be studied in reference to other factors, types of feeding, single and plural births, age of mother, order of birth, earnings of father, employment of mother, etc.; if the proportion of male births does not vary with these other factors, the conclusion may be accepted as expressing the true excess mortality among male births.

On the other hand, an analysis of a group of births into single and plural births shows (1) that about 2 per cent of all births are twins or triplets, and (2) that the mortality among twins and triplets is between three and four times that among single births. The prevalence of twins and triplets is then studied with regard to other factors, age of mother, order of birth, type of feeding, earnings of father, employment of mother, etc. If the analysis indicates that twins and triplets are slightly more prevalent among births to older mothers and among births of later orders, and that they are more likely to be artificially fed, the tentative conclusion as to relative excess mortality among twins and triplets over that among single births is subject to modification. The amount of modification arising from its correlation with artificial feeding, for example, will be greater the larger the proportion of twins and triplets artificially fed and the greater the excess mortality among artificially fed over that among breast-fed infants.[1] But with regard to each factor with which the proportion of twins and triplets is associated, the question arises whether the higher mortality among artificially fed, among the births to older mothers, and among the births of late orders is wholly or in part determined or influenced by the greater prevalence of twins and triplets.[2] The question, therefore, of the degree of modification of the tentative conclusions can be determined only after analysis.

The first recourse in analysis is usually to that universally applicable method, simple classification, or, as it may be termed when several factors are included, multiple classification. If births and deaths are classified each by the same factors, such as earnings of father or nationality of mother, the rates of mortality indicate whether the factors used in the classification can be considered as having an influence upon infant mortality. If two factors such as the two cited are correlated, the births and the deaths must be subclassified; the rates by earnings of father in each nationality group indicate whether earnings of father can be considered a factor independent of nationality, and the rates by nationality of mother in each earnings group indicate whether nationality of mother can be considered a factor independent of earnings. Evidently by this mode of comparison the effect of one factor upon the rate can be studied by the simple device of studying its influence in a group within which another factor does not vary. Multiple classification, if carried far enough, possesses the essential requirements for isolating the effect of a single factor.[3] But as more and more classifications are introduced, on the one hand the results become increasingly difficult for the mind to grasp, and on the other, the material becomes more and more subdivided until, finally, the base becomes too small to ensure valid conclusions. To meet the first of these difficulties, recourse may be had to the familiar process of selection of data. For example, the influence of varying prevalence of plural births may be eliminated by confining the analysis to single births, and the influence of differences in types of feeding may be eliminated by further omitting all except breast-fed infants. But to obviate the difficulty that the numbers in the final group may not be large enough to ensure valid results, recourse must be had to some method of summation.

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[1] The degree of excess mortality of twins and triplets over that among single births may itself vary with the type of feeding.

[2] In this particular illustration the influence of the greater prevalence of twins and triplets among the artificially fed upon the relative mortality among artificially as compared with breast-fed infants is not great.

[3] In mathematical terms, assuming that all causal factors can be expressed numerically, the infant mortality rate, $X_1$, can be stated in terms of its several independent causal factors: $X_1 = f\,(X_2, X_3, X_4 \;.\;.\;.\;.\; X_n)$ where $X_2$, $X_3$, etc., are the independent causal factors. The partial derivative of $X_1$ with respect to any one factor, for example, $\frac{\delta X_1}{\delta X_2}$, measures the change in $X_1$ due to the change in $X_2$; in other words, measures the influence of $X_2$ upon $X_1$ when all other variables are considered constant. Geometrically, this partial derivative is the slope of $X_1$ measured along the axis of $X_2$. In a classification table, for example, Table V, values of $X_1$ are given for different values of $X_2$, with other factors, so far as they are included in the classification table, constant.

To meet these difficulties in the use of the method of multiple classification recourse may be had to the method of expected deaths developed by Professor Harald Westergaard.[1] This method, in fact, offers a simple and easily applicable way of isolating the influence of a single factor from that of other associated factors, and of stating the results in clear and definite terms.

Because the wide applicability of the Westergaard method seems not to be generally appreciated in this country, it will be described briefly before returning to the subject of its application to a specific infant mortality problem. Though designated as the "method of expected deaths" on account of its first application to mortality data, it is not restricted in its application to these problems but can be applied to a great many other fields, and in these fields it might be termed the method of "expected cases," or, generally, "expected results." The essence of the method lies in so calculating the expected numbers that a comparison between them and the actual numbers will be free from the disturbing influence of one, two, or several factors. By this means the effect of a single cause is isolated from the influences of other causes.

The best known, as well as the earliest, applications of the method were to the problems of eliminating variations in age and sex composition in comparisons of mortality rates in urban and rural populations and of eliminating variations in age composition in comparisons of occupational mortality.[2] Since, in these applications, identical or

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[1] *Die Lehre von der Mortalität und der Morbilität: Anthropologisch Statistiche Untersuchungen.* Jena. G. Fisher, 1882, pp. 28–30; and "Scope and Method of Statistics," this JOURNAL, Vol. XV, No. 115, Sept., 1916, pp. 260–64.

[2] The method of standardizing or correcting death rates for differences in age composition was clearly set forth in the introductory chapter of *Die Lehre von der Mortalität*, pp. 28–30. In England, in the Registrar-General's Report for 1882, this method of correcting for varying age composition in comparison of urban and rural districts was used. (Forty-fifth Annual Report of the Registrar-General of Births, Marriages, and Deaths in England, Abstracts of 1882, C–4009 London, 1884.) The use of corrected death rates for Hamburg by Koch in 1883 is mentioned by Von Mayr, *Statistik und Gesellschaftslehre*, Vol. II, p. 219. Westergaard himself mentions the use of the method of expected deaths by Ratcliffe, in a first report, *Observations on the Rate of Mortality and Sickness amongst Friendly Societies*, Manchester, 1850, quoted in *Die Lehre von der Mortalität*, p. 287. Ratcliffe, however, seems not to have appreciated its importance, for in a second report the method was apparently not used.

"standard" rates were applied to varying populations, or varying rates to identical or "standard" populations, the method is perhaps better known to English and American statisticians as the method of standards. But there is this difference: the name "method of standards," by suggesting that any standard is equally good, has sometimes led to the use of a standard that was not adapted to the particular problem; while the "method of expected cases," by comparing expected with actual numbers, always keeps as close as possible to the actual problem under consideration.[1]

With this preliminary statement, we may proceed to a study of the actual operation of the method in which its merits and its limitations will be revealed much more clearly than by mere description. The first question chosen to illustrate the operation of this method of expected deaths is that of determining the influence of order of birth upon infant mortality.[2] Order of birth is closely associated with age of mother, since a large proportion of the births of later orders are to the older mothers; it is also correlated to some extent with the prevalence of twins and triplets; and it is correlated slightly with low income, since larger families as measured by the number of births are more prevalent at the lower income levels.

TABLE I

AGE OF MOTHER AND ORDER OF BIRTH; LIVE BIRTHS IN EIGHT CITIES

| Order of birth | Live births | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Total | Age of mother | | | | | | |
| | | Under 20 | 20–24 | 25–29 | 30–34 | 35–39 | 40 and over | Not reported |
| Total | 22,967 | 1,584 | 6,879 | 6,618 | 4,231 | 2,688 | 958 | 9 |
| First | 6,230 | 1,227 | 3,125 | 1,349 | 399 | 114 | 14 | 2 |
| Second | 4,954 | 311 | 2,196 | 1,621 | 599 | 204 | 22 | 1 |
| Third | 3,328 | 39 | 968 | 1,407 | 609 | 260 | 45 | . |
| Fourth | 2,481 | 5 | 412 | 1,043 | 694 | 268 | 57 | 2 |
| Fifth | 1,767 | 2 | 133 | 624 | 631 | 306 | 69 | 2 |
| Sixth | 1,263 | .... | 32 | 339 | 480 | 326 | 85 | 1 |
| Seventh | 921 | .... | 9 | 138 | 353 | 320 | 101 | . |
| Eighth | 677 | .... | 3 | 68 | 226 | 289 | 91 | . |
| Ninth | 470 | .... | 1 | 20 | 126 | 224 | 98 | 1 |
| Tenth and later | 876 | .... | .... | 9 | 114 | 377 | 376 | . |

Table I presents a distribution of live births classified by age of mother and order of birth.[3] An inspection of the distribution shows at once that the lower orders of birth are associated with the younger ages and the higher orders with the higher ages. The infant mortality rates for the order of birth groups beginning with first births are 104.7, 95.7, 104.6, 108.8, 118.8, 122.7, 136.8, 135.9, 146.8, and for tenth and over, 181.5. It may be noted that the rate for first births is higher than that for second, and that there is a rapid increase in rate from 95.7 for second to 181.5 for births tenth and later in order. The average rate for births of all orders is 111.2; expressing this average as 100, the following numbers show the variation in rates by order: 94.2, 86.1, 94.1, 97.8, 106.8, 110.3, 123.0, 122.2, 132.0, 163.2. The rates for age-of-mother groups are: Under 20, 135.7; 20–24, 109.3; 25–29, 101.4; 30–34, 104.7; 35–39, 126.5; and 40 and over, 136.7.

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[1] Compare the recent discussion of the best methods of choosing weights in the problem of measuring price increases—one of the familiar examples of the method of standards.

[2] For a similar application of the method to this problem see Westergaard, *op. cit.*, Revised ed., 1901, pp. 371–75.

[3] The material is for live births in selected years in eight cities studied by the Children's Bureau, and is taken from a report on infant mortality shortly to be issued.

In view of the fact that the infant mortality rates among births to older mothers are high and that these are largely births of the later orders, the question arises whether the age of mother is the factor that produces the high rate among the births of later orders, whether the order of birth is itself the causal element, or whether both factors contribute to the result.

This question can be answered by ascertaining what the rates by order of birth would have been on the assumption that age of mother is the sole causal factor, and comparing the actual with these calculated rates. Applying the average rates by age of mother to the distribution of births by order of birth and age of mother, the deaths in each sub-group can be calculated; the deaths in each order-of-birth group can then be added, and these totals compared with the actual deaths that occurred. If order of birth has no causal influence aside from its correlation with age of mother, the number of actual and of expected deaths will be equal. If, however, the actual deaths do not equal those

TABLE II

RELATIVE MORTALITY BY ORDER OF BIRTH, WHEN INFLUENCE OF AGE OF MOTHER IS ELIMINATED; LIVE BIRTHS IN EIGHT CITIES

| Order of birth | Deaths | | | Ratio of original rate to average |
|---|---|---|---|---|
| | Actual | Expected | Ratio of actual to expected | |
| Total | 2,555 | 2,555.3 | 100.0 | 100.0 |
| First | 652 | 704.1 | 92.7 | 94.2 |
| Second | 474 | 538.6 | 88.0 | 86.1 |
| Third | 348 | 356.8 | 97.6 | 94.1 |
| Fourth | 270 | 266.5 | 101.2 | 97.8 |
| Fifth | 210 | 192.7 | 109.0 | 106.8 |
| Sixth | 155 | 141.2 | 109.7 | 110.3 |
| Seventh | 126 | 106.2 | 118.4 | 123.0 |
| Eighth | 92 | 79.9 | 115.2 | 122.2 |
| Ninth | 69 | 57.3 | 120.2 | 132.0 |
| Tenth and later | 159 | 112.0 | 142.0 | 163.2 |

expected, the influence of order of birth or of other factors associated with it is revealed in the proportion by which the actual deaths fall short of or exceed the expected deaths. The figures in Table II show the actual deaths in comparison with deaths when the influence of age of mother is eliminated.

The explanation of this calculation can be phrased in other terms. The series of ratios show, in fact, the influence of order of birth (together with associated factors) when the effect of the disproportionate weighting of the various groups with births to younger or to older mothers is eliminated, or, more simply, when the influence of age of mother is eliminated from the relative rates.

The effect of eliminating the influence of age of mother appears slightly to diminish the excess mortality of first as compared with second births, and to lessen the excess mortality of births of later as compared with births of earlier orders. The influence of order of birth, though diminished, is still marked.

Table III presents a similar computation showing the influence of order of birth after additional factors are eliminated, to wit, earnings of father and plurality of birth. The computations made in constructing this table are much more complicated than those made in constructing the preceding one, since each group of births classified by earnings of father, order of birth, and age of mother is multiplied by the average rate in the corresponding earnings-of-father and age-of-mother group; the results are then totaled to give the expected deaths by order of birth. These expected deaths are the numbers that would be expected if full weight were given to the factors age of mother and earnings of father, but if no influence of order of birth were present. The differ-

TABLE III

RELATIVE MORTALITY BY ORDER OF BIRTH, WHEN INFLUENCES OF AGE OF MOTHER AND EARNINGS OF FATHER ARE ELIMINATED; SINGLE LIVE BIRTHS IN SEVEN CITIES

| Order of birth | Deaths | | |
|---|---|---|---|
| | Actual | Expected | Ratio of actual to expected |
| Total | 2,196 | 2,196.0 | 100.0 |
| First | 586 | 589.8 | 99.4 |
| Second | 410 | 454.3 | 90.2 |
| Third | 297 | 302.3 | 98.2 |
| Fourth | 232 | 232.9 | 99.6 |
| Fifth | 175 | 168.7 | 103.7 |
| Sixth | 119 | 124.0 | 96.0 |
| Seventh | 108 | 95.9 | 112.6 |
| Eighth | 75 | 71.6 | 104.7 |
| Ninth | 61 | 54.5 | 111.9 |
| Tenth and later | 133 | 101.8 | 130.6 |

ences between the actual and expected deaths show, as before, the influence of order of birth after the disturbing effects of these other factors have been eliminated.

It is of interest to note that the general trend of the rate by order of birth remains unaltered; the first births have a slightly higher rate than the second, and from the second there is a general tendency to increase with the later orders. The elimination of the two additional factors—earnings of father and plural birth—tends, however, to reduce still further the influence of order of birth as compared with that indicated by the original averages.

A second question concerns the influence of age of mother. Table IV presents the relative ratios between the average rate and the rates for each age-of-mother group, first with no eliminations, second, when the influence of order of birth is eliminated, and third, when the influences of order of birth, earnings of father, and plural births are eliminated.

TABLE IV

RELATIVE MORTALITY BY AGE OF MOTHER, WHEN INFLUENCE OF CERTAIN OTHER FACTORS IS ELIMINATED; LIVE BIRTHS IN EIGHT CITIES

| Age of mother | Ratio of actual to expected deaths | | |
|---|---|---|---|
| | On basis of average rate | Eliminating influence of order of birth | Eliminating influence of order of birth, earnings of father, and plural births |
| Total | 100.0 | 100.0 | 100.0 |
| Under 20 | 121.2 | 131.8 | 121.3 |
| 20–24 | 98.5 | 106.8 | 101.9 |
| 25–29 | 91.2 | 95.2 | 95.5 |
| 30–34 | 94.2 | 90.4 | 93.3 |
| 35–39 | 113.8 | 97.5 | 105.3 |
| 40 and over | 122.9 | 92.4 | 91.1 |

The effect of eliminating the influence of order of birth appears in the removal of the high mortality rate among the older mothers, which appears to be due largely to the influence of the high mortality rate attending births of late orders. The effect of eliminating the influence of earnings of father appears in lessening the excess mortality among the young mothers, a large proportion of whom are in families with low earnings.

Since the primary purpose of this paper, as stated above, is to illustrate the application of Professor Westergaard's method of isolating the influence of the several factors, these examples may perhaps suffice. They are not intended to suggest that the analysis made is sufficient, but are presented to show how the method can be applied to eliminate one, two, or more factors. As many factors should be eliminated as a thorough consideration of the problem shows to be necessary. In many cases, however, the limitations in the amount or in the character of material available do not allow the exhaustive analysis that the nature of the problem requires.

One suggestion might be made as to an appropriate notation to express the operations and results of multiple classification and of the method of expected deaths. Letting 1 denote the infant mortality rate, 2 order of birth, 3 age of mother, 4 earnings of father, 5 nationality of mother, 6 plural births, and similar subscripts for other factors, then Table I, for example, may be designated briefly B 2.3, or births classified by age of mother and order of birth. If subclassification by nationality of mother is introduced the table becomes B 2.3–5. Letting $R$ denote the series of ratios of actual and expected deaths that shows the influence of a given factor such as order of birth upon the infant mortality rate, then the relation between the rate and order of birth may be stated simply $R_{1.2}$; if a factor such as age of mother is eliminated, it may be indicated by placing the corresponding number after a colon following the numbers indicating the relation shown, thus $R_{1.2:3}$. The third column of ratios in Table IV, for example, may be designated, $R_{1.3:2-5-6}$.

Among the limitations of the method considered in this paper may be mentioned the following points: (1)The method requires a considerable amount of computation if more than one or two factors are eliminated; (2) the application of the method requires a mass of material commensurate with the number of factors to be eliminated, though no more than would be required by any other equally satisfactory method; (3) since it is an averaging process the method will yield satisfactory results only when an average is appropriate.

The last point may be illustrated by Table V, which shows infant mortality rates classified by age of mother and order of birth. Among births to young mothers the rate of infant mortality rises sharply from first to third; while among births to mothers of the oldest groups shown the rate, high for first births, falls to a minimum for third births and rises to a very high figure for births tenth and later in order. These characteristic variations of the rate are obscured by an averaging process,[1] unless such a process takes into account the interval between births which also enters as a factor in this case. Again, the averaging process indicated (Table IV) that age of mother was not an unfavorable element in the rate of mortality among infants of older mothers; but the classified table of rates shows that for first births the infant mortality rate is higher among births to older mothers than to mothers between 25 and 29 years of age.

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[1] In mathematical terms, the partial derivative which measures the contribution of $X_2$ to $X_1$ when other factors are held constant may in general contain constant terms in $X_3$, $X_4$, and other factors. The condition that the partial derivative shall not vary with $X_3$, $X_4$, etc., requires an averaging process to find an expression for $\frac{\delta X_1}{\delta X_2}$ that contains no terms in any other variable. Such a process is ap-

A further difficulty arising from this averaging process is the question of the effect of the weights chosen. The results, as can easily be shown, may vary considerably according to the weights. In this respect the method has the same advantages and the same weaknesses as the method of standardizing or correcting death rates, or of measuring price increases. Experience has indicated as a general rule to be followed that the weights chosen should agree as closely as possible with the "natural" weighting in the problem studied. Thus, if it is desired to eliminate the influence of age of mother, the actual weighting of the births by order of births and age of mother yields the most satisfactory results and introduces no new element of arbitrary weighting into the problem. Care must always be exercised, however, in applying the method to determine whether the results are affected by the weights. Errors of interpretation arising from these difficulties

TABLE V

INFANT MORTALITY RATES, BY AGE OF MOTHER AND ORDER OF BIRTH; LIVE BIRTHS IN EIGHT CITIES

| Order of birth | Infant mortality rate [1] | | | | | | |
|---|---|---|---|---|---|---|---|
| | Total | Age of mother | | | | | |
| | | Under 20 | 20–24 | 25–29 | 30–34 | 35–39 | 40 and over |
| Total | 111.2 | 135.7 | 109.3 | 101.4 | 104.7 | 126.5 | 136.7 |
| First | 104.7 | 125.5 | 100.5 | 90.4 | 102.8 | 131.6 | ..... |
| Second | 95.7 | 167.2 | 105.6 | 74.0 | 76.8 | 112.7 | ..... |
| Third | 104.6 | ..... | 125.0 | 103.8 | 82.1 | 73.1 | ..... |
| Fourth | 108.8 | ..... | 155.3 | 99.7 | 106.6 | 82.1 | ..... |
| Fifth | 118.8 | ..... | 97.7 | 136.2 | 96.7 | 127.5 | ..... |
| Sixth | 122.7 | ..... | ..... | 150.4 | 102.1 | 128.8 | ..... |
| Seventh | 136.8 | ..... | ..... | 195.7 | 121.8 | 131.3 | 108.9 |
| Eighth | 135.9 | ..... | ..... | ..... | 137.2 | 121.1 | ..... |
| Ninth | 146.8 | ..... | ..... | ..... | 174.6 | 133.9 | ..... |
| Tenth and later | 181.5 | ..... | ..... | ..... | 228.1 | 193.6 | 159.6 |

[1] Rates are not shown where base is less than 100.

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propriate only when the types and values of the partial derivative do not vary materially for different values of other variables.

If the additional condition is imposed that the partial derivative with respect to each factor be a constant, the expression becomes linear and corresponds to the familiar partial straight line regression equation $X_1 = b_{12.34} \ . \ . \ . \ X_2 + b_{13.24} \ . \ . \ . \ X_3$, etc.

It is clear that the application of the Westergaard method is somewhat broader than that of the partial straight line regression equation, and that the latter is equally inapplicable to cases in which an averaging process obscures the true significance of the variations in the rates.

can always be avoided by a study of the rates classified by the several factors.

Among the advantages of the method are the following: (1) The results are stated in clear and simple terms; (2) the numbers upon which the results are based can be presented and the validity of the result judged thereby; (3) the method requires the constant use of the original material, which often suggests the necessity of taking into account factors, such as age of infant in connection with type of feeding, which might otherwise be overlooked; (4) it can be applied in certain cases even when the material cannot be classified so as to yield the full detail of rates;[1] (5) it is not restricted to linear relationships but indicates any type of average relationship which may exist; (6) it is not restricted to factors which can be expressed numerically but can be applied equally well to factors, such as nationality and employment of mother, which are not susceptible of statement in numerical terms; and (7) it places in true relation the actual effect of each contributing factor after the influences of other factors have been eliminated.

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[1] For example, if the births can be fully but the deaths or stillbirths only partially classified. See Westergaard, *op. cit.*, Revised ed., pp. 333, 336; and "Scope and Method of Statistics," *loc. cit.*, p. 262.

# NOTES

## DISTRIBUTION OF MEN PHYSICALLY UNFIT FOR MILITARY SERVICE

By Rufus S. Tucker

The publication of the results of the examinations of drafted men in the recent war has furnished fresh material for the old arguments concerning the relative healthfulness of urban and rural life and the physical strength and resistance of the various races found in this country. As is usual in such cases, the statistics can be interpreted variously, even assuming their completeness and accuracy. As a result, many decided opinions have been put forth without much to back them and have been accepted or criticized according as they did or did not fit with the general ideas or local patriotisms of the reader. This article is an attempt to criticize these statistics and to suggest some conclusions which, though not proved, seem probable.

The most complete analysis of draft statistics is to be found in the War Department's publication, *Defects Found in Drafted Men*, prepared under the direction of Majors A. G. Love and C. B. Davenport and published in 1920. Other sources of information, frequently at variance with the preceding material and with each other, are the "Second Report" of the Provost Marshall General, dated December 20, 1918, and the "Final Report" of the same official, dated July 15, 1919. None of these, in my opinion, furnishes sufficient information for sound deductions concerning the physical condition of specific sections or classes of our population, for reasons to be explained.

Mr. Love and Mr. Davenport, realizing the variations in standards of local examining physicians, did not publish the ratio of cases of rejections or disabilities to the total number of men actually examined. They based all their ratios, instead, on a hypothetical total, or rather, two hypothetical totals, one of 3,241,987, the other of 2,753,922—the one for the comparison of rejections, the other for the comparison of defects. These hypothetical totals were obtained by assuming that the men who had been passed by the local boards and who were not reëxamined at a cantonment would have been rejected (or found defective) on reëxamination at camp in the same proportion that had obtained in actual examinations of other men from their states. On this assumption they arrived at a hypothetical number of rejections for each state, which, unfortunately, they did not publish. They did, however, publish the actual number of rejections and the ratio of the assumed rejections to the number of registrants examined by local boards in each state. Dividing the actual rejections by these ratios, and adding the states together, gives the hypothetical total mentioned above. It is important to note that the number of actual examinations considered by them is 1,961,692 at the camps plus 549,099 rejections and 1,253,310 acceptances by local boards, a total of 3,764,000 cases. There were 705,000 other men sent to camp, whose records, although available, were not analyzed.

The Provost Marshall General's figures for physical rejections, in his Final Report, are based on a total of 17,593,778 men classified, but not more than 6,554,000 of these were examined physically,[1] and these local examinations were very uneven in quality. The analyses in the Provost Marshall General's Second Report are based on only 3,218,000 examinations.

The proportionate numbers of rejected men by states given in these reports cannot be accepted as correct indexes of the condition of the population of those states, since they omit the large number of men who were never examined by the draft officials, either of the local boards or of the camps, because they were already in the service. There were about 1,850,000 of these,[2] all of course physically fit; and inasmuch as the proportion of volunteers to the number of men physically examined by draft officials in each state differed greatly, their omission seriously altered the relative standing of the states. Some of these men may have had physical defects of some sort, but it is obvious that these were not sufficient to cause rejection. Unfortunately the exact districts from which these men came cannot be ascertained; they are grouped by states only. Moreover, there is no way of ascertaining how many were within the age limits 21 to 31. It is possible, however, to obtain totals by states of all men, 18 to 45 years of age, who joined the army or the navy after registering for the draft, and comparisons that take these men into account are, I believe, more significant than the published ones. To omit the volunteers would be as misleading as if a milk inspector should attempt to compare samples some of which had been skimmed and some not, for there is no doubt that they were, physically at least, the cream of the population. The importance of allowing for these men is apparent if one considers that they were equal in number to over 28 per cent of the total examined by draft officials. The relative standing of states is affected much more by this factor than by the differences in local standards which the War Department report is so careful to eliminate; for the proportion of rejections at camps averaged only 7 per cent of those reëxamined, varying from 2.6 per cent to 11 per cent in different states, and amounted to only 138,000 men in all; whereas the proportion of volunteers varied from about 20 per cent in South Carolina to over 55 per cent in the District of Columbia, and the total number was, as already stated, about 1,850,000. The omission of volunteers from the averages gives an especially misleading impression of Oregon, Rhode Island, and Massachusetts.

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[1] It is impossible to reconcile the figures given in different parts of the Provost Marshall General's reports on this and many other points, partly because of obvious errors in arithmetic, partly because of insufficient explanation. Incidentally, nearly all the charts accompanying the Final Report have incorrect titles.

[2] There were 378,619 in the military or naval service at the outbreak of war (*P. M. G. 2d Report*, p. 227); and 1,471,076 volunteers during the war (*P. M. G. Final Report*, p. 14).

It would be possible to work out from the Surgeon General's report the assumed number of rejections and to obtain a table of rejection ratios by dividing this number by the sum of those examined by the local boards and the volunteers. But only one third of the local boards' examinations need to be corrected for low standards, as 1,962,000 of them were revised by camp examiners; and there is no way of telling whether the 549,000 rejections by local boards included many cases that should not have been rejected. Moreover, it is not certain that the number of rejections at camp of men passed by local boards is not partly a result of the idiosyncracies of camp examiners as well as the carelessness or the incompetency of local doctors. It is also far from certain that the proportions rejected on reëxamination at camp would be the same for each state if the remaining men had been examined as the proportion rejected of the "second million," as is assumed by the authors of the Surgeon General's report. The "first million" and the "second million" showed striking differences in this respect.

It is probable, as the official report states, that the examinations, both local and at camp, were abnormally severe in New England and New York. On the other hand, Maine, Michigan, Missouri, Virginia, South Carolina, Georgia, Kentucky, Alabama, Mississippi, Oregon, and California were less strict than other states contributing to the same cantonments, and Camps Meade, Lee, Taylor, Dodge, Funston, and Pike are thought not to have been so strict as the other camps.[1] In general, the states that furnished the most volunteers also had careful examinations. Finally, it must be borne in mind that there were a great many men between the ages of twenty-one and thirty-one who enlisted in the army, navy, national guard, or marine corps before the draft registration date, and who were therefore not included in the draft statistics. It is estimated that there were 625,000 such cases,[1] but there is no way of apportioning them to states. The percentage of rejections for the United States as a whole would be 13.1 per cent of the men 21 to 31 years of age if this estimate is correct.

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[1] See *Defects*, pp. 44, 193, 194, 197; *2d Report, P. M. G.*, p. 164.

For the foregoing reasons it has not seemed worth while to attempt to obtain more correct ratios of rejections of men aged 21–31, but rather to attempt an analysis of those aged 18–45 on the basis of the figures contained in the reports of the Provost Marshall General.

TABLE I

PROPORTION OF ALL MEN EXAMINED WHO WERE REJECTED ON ACCOUNT OF PHYSICAL OR MENTAL DISABILITY (7,019,000 CASES)

| Order of state | State | Per cent | Order of state | State | Per cent |
|---|---|---|---|---|---|
| 1 | Arizona | 20.24 | 26 | Mississippi | 13.18 |
| 2 | New Mexico | 20.14 | 27 | Delaware | 13.13 |
| 3 | Maine | 19.74 | 28 | Utah | 13.04 |
| 4 | Georgia | 19.05 | 29 | Iowa | 12.63 |
| 5 | Colorado | 18.83 | 30 | Oregon | 12.49 |
| 6 | Tennessee | 18.63 | 31 | Minnesota | 12.48 |
| 7 | Rhode Island | 18.56 | 32 | Pennsylvania | 12.43 |
| 8 | Michigan | 18.20 | 33 | Nebraska | 12.19 |
| 9 | Vermont | 17.22 | 34 | West Virginia | 12.18 |
| 10 | Virginia | 16.07 | 35 | New Jersey | 12.12 |
| 11 | Kentucky | 15.95 | 36 | North Dakota | 12.10 |
| 12 | South Carolina | 15.84 | 37 | Texas | 11.91 |
| 13 | Washington | 15.77 | 38 | Florida | 11.21 |
| 14 | North Carolina | 15.64 | 39 | Idaho | 10.84 |
| 15 | Maryland[1] | 15.22 | 40 | Nevada | 10.74 |
| 16 | New York | 14.49 | 41 | Arkansas | 10.68 |
| 17 | Louisiana | 14.38 | 42 | Ohio | 10.52 |
| 18 | District of Columbia | 14.34 | 43 | Alabama | 10.43 |
| 19 | Connecticut | 14.19 | 44 | Montana | 10.40 |
| 20 | Missouri | 14.06 | 45 | Kansas | 10.27 |
| 21 | South Dakota | 14.05 | 46 | Indiana | 9.88 |
| 22 | Massachusetts | 13.87 | 47 | California | 8.58 |
| 23 | New Hampshire | 13.47 | 48 | Wyoming | 7.40 |
| 24 | Illinois | 13.27 | 49 | Oklahoma | 7.00 |
| 25 | Wisconsin | 13.27 | | | |
| | | | | Average of United States | 13.19 |

[1] Based on the number of rejections given in the Surgeon General's report, p. 417. The Provost Marshall General's figures for this state are contradictory and obviously erroneous.

Since the number of men involved is much larger, and since many of them were examined by regular army or navy surgeons, the effect of local variations in physicians' standards will presumably be minimized. This analysis has been made by adding to the number of men registered in each state the number not registered on account of being members of the national guard in federal service on April 1, 1917, or having enlisted in the national guard or the regular army between April 2 and June 30, 1917. There is a certain amount of duplication here on account of those who enlisted after registering on June 5. There is also included a very small number of men over 45 years of age. On the other hand, those who, without registering for the draft, enlisted in the navy or the marine corps or in the regular army before April 1, or in any branch of the service after July 1, 1917, are not included, as there are no statistics available. The result of this analysis is given in Table I, which shows the condition of all men of military age, 18 to 45, who were physically examined by draft officials, and nearly all of those who were examined by recruiting officers not connected with the draft. Table II presents for comparison the order of the states and ratios published by Love and Davenport, and by the Provost Marshall General in his Second Report.

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[1] *P. M. G. 2d Report*, p. 31.

Accepting Table I, then, as best representing the physical condition of the male population of military age in the different states, what can we deduce as to the causes of the differences between states? It

TABLE II

PROPORTION REJECTED ON ACCOUNT OF PHYSICAL OR MENTAL DISABILITY

| Surgeon General's Report (3,764,000 cases) | | | Provost Marshall General's Report (3,218,000 cases) | | |
|---|---|---|---|---|---|
| Order of State | State | Per cent | Order of state | State | Per cent |
| 1 | Rhode Island | 42.44 | 1 | Arizona | 34.90 |
| 2 | Vermont | 35.39 | 2 | Rhode Island | 28.67 |
| 3 | Maine | 34.60 | 3 | Michigan | 23.18 |
| 4 | Massachusetts | 26.73 | 4 | Washington | 22.83 |
| 5 | California | 26.50 | 5 | Vermont | 22.55 |
| 6 | Washington | 26.28 | 6 | Colorado | 21.94 |
| 7 | Tennessee | 24.56 | 7 | California | 21.66 |
| 8 | Virginia | 24.56 | 8 | Connecticut | 20.79 |
| 9 | Maryland | 24.43 | 9 | New York | 19.31 |
| 10 | New York | 24.05 | 10 | Massachusetts | 18.64 |
| 11 | Louisiana | 23.91 | 11 | Virginia | 18.31 |
| 12 | Michigan | 23.31 | 12 | Maryland | 18.27 |
| 13 | Connecticut | 22.66 | 13 | South Carolina | 17.24 |
| 14 | Georgia | 22.51 | 14 | Maine | 17.16 |
| 15 | South Carolina | 22.25 | 15 | Tennessee | 16.72 |
| 16 | Oregon | 21.98 | 16 | Missouri | 16.53 |
| 17 | Utah | 21.93 | 17 | Georgia | 16.16 |
| 18 | Colorado | 21.35 | 18 | New Jersey | 15.82 |
| 19 | North Carolina | 21.34 | 19 | North Carolina | 15.68 |
| 20 | Pennsylvania | 20.93 | 20 | Minnesota | 15.37 |
| 21 | New Jersey | 20.89 | 21 | Illinois | 15.35 |
| 22 | Kentucky | 20.73 | 22 | Texas | 15.29 |
| 23 | Missouri | 20.69 | 23 | Indiana | 15.29 |
| 24 | New Mexico | 20.66 | 24 | Wisconsin | 15.25 |
| 25 | Iowa | 20.41 | 25 | Pennsylvania | 15.12 |
| 26 | New Hampshire | 20.31 | 26 | North Dakota | 14.91 |
| 27 | Illinois | 20.25 | 27 | Oregon | 14.65 |
| 28 | Wisconsin | 20.04 | 28 | Kentucky | 14.64 |
| 29 | Florida | 19.98 | 29 | West Virginia | 14.52 |
| 30 | Mississippi | 19.98 | 30 | Florida | 14.50 |
| 31 | Delaware | 19.80 | 31 | Idaho | 14.44 |
| 32 | Minnesota | 18.97 | 32 | Utah | 14.42 |
| 33 | Ohio | 18.79 | 33 | New Mexico | 14.39 |
| 34 | South Dakota | 18.76 | 34 | Nevada | 14.27 |
| 35 | Nevada | 18.60 | 35 | Mississippi | 14.06 |
| 36 | Oklahoma | 18.49 | 36 | Iowa | 13.96 |
| 37 | Indiana | 18.35 | 37 | Louisiana | 13.94 |
| 38 | Idaho | 17.96 | 38 | Ohio | 13.81 |
| 39 | Alabama | 17.96 | 39 | New Hampshire | 13.59 |
| 40 | West Virginia | 17.76 | 40 | Alabama | 13.55 |
| 41 | Texas | 17.59 | 41 | Arkansas | 13.08 |
| 42 | North Dakota | 16.70 | 42 | Delaware | 12.94 |
| 43 | Arkansas | 16.39 | 43 | Nebraska | 12.91 |
| 44 | Montana | 16.27 | 44 | Montana | 12.68 |
| 45 | District of Columbia | 16.25 | 45 | Kansas | 12.37 |
| 46 | Arizona | 15.33 | 46 | Wyoming | 12.36 |
| 47 | Kansas | 14.73 | 47 | South Dakota | 12.13 |
| 48 | Nebraska | 13.46 | 48 | District of Columbia | 11.56 |
| 49 | Wyoming | 12.81 | 49 | Oklahoma | 9.78 |
| | Average of United States | 21.21 | | Average of United States | 16.25 |

is very misleading to assume without question that race is the determining factor, and to assert, as Love and Davenport have done, that because the census shows a certain race to be very numerous in a certain district, that race is responsible for the showing made by that district. This deduction is reasonable enough in the case of Indians, negroes, and native whites of foreign parentage, who were subject to the draft law, but is not so justifiable in the case of the foreign-born, since only about one half of them were subject to the draft. Of course the analysis by sections, given by Love and Davenport, is further vitiated by the omission of voluntary enlistments.

Of the fifteen states that have the highest proportion of negroes in their population, nine [1] show a very high proportion of rejections, in spite of the fact that several of them are supposed to have had medical examiners who were rather easily satisfied. Members of other colored races are too few in number to affect the relative standing of states, unless the Indians in Arizona have something to do with the poor showing of that state.

Of the twelve highest states, in proportion of rejections, seven [2] have an unusually large number of native whites of native parentage, and [3] of the lowest twelve, eight show the same phenomenon. Plainly, this proves nothing. Looking at the same problem from another angle we find that five [4] of the high states have an unusual proportion of natives of foreign or mixed parentage; while of the low twelve,[5] six have large numbers of that class. These ambiguous results are probably due principally to the fact that where foreigners are numerous, negroes are scarce, and vice versa, although there is reason to believe that some of the foreign nationalities differ little from the native stock.

Even if the fifteen states with large negro populations be taken out of consideration, it is difficult to prove a correlation between foreign racial elements and physical disability. The figures are inconclusive: they seem to show that native whites of native parentage are slightly superior to those of foreign origin, but there are so many factors involved that no certain conclusions can be established. The study of selected districts by the Provost Marshall General in his Second Report is in some respects more convincing, but is far from decisive. It is to be hoped that the War Department will see fit to analyze its records of individuals in the service according to color, place of birth, and resi-

[1] Md., D. C., Va., N. C., S. C., Ga., Ky., Tenn., La. These and following statements are based on the census of 1910 unless otherwise indicated.

[2] Me., Vt., Va., Ky., Tenn., Colo., and N. M.

[3] Ind., Ohio, Kans., Ala., Ark., Okla., Idaho, and Wyo.

[4] Vt., R. I., Mich., Colo., and Ariz.

[5] Ohio, Kan., Mont., Idaho, Wyo., and Calif.

dence, and to publish average heights and weights, and the color of hair and eyes.

With reference to the relative standing of rural and urban states we find that of the twelve states highest in their ratio of rejections, three[1] were in 1910 more urban than the United States as a whole, and of the twelve lowest only two[2] were more urban. The corresponding figures for 1920 are two[3] and two. It is evident that these figures do not prove any superiority of the country over the city. The problem is complicated by the predominance of natives in the country and of foreigners in the cities, and by the fact that the negro population is mainly rural. In addition it is necessary to consider the extent of selection as a result of internal migration.

TABLE III

PROPORTION REJECTED ON ACCOUNT OF MENTAL OR PHYSICAL DISABILITY, AGE 18 YEARS (247,000 CASES)

| Order of state | State | Per cent |
|---|---|---|
| 1 | Ohio | 10.0 |
| 2 | Tennessee | 8.1 |
| 3 | Rhode Island | 6.9 |
| 4 | Iowa | 6.2 |
| 5 | North Dakota[1] | 6.0 |
| 6 | Delaware[1] | 5.8 |
| 7 | Nebraska | 5.7 |
| 8 | Connecticut | 5.3 |
| 9 | Vermont[1] | 5.3 |
| 10 | Maine[1] | 5.2 |
| 11 | Kentucky | 5.1 |
| 12 | Georgia | 4.9 |
| 13 | New York | 4.9 |
| 14 | New Hampshire[1] | 4.9 |
| 15 | Oregon | 4.6 |
| 16 | North Carolina | 4.4 |
| 17 | Wisconsin | 4.4 |
| 18 | Oklahoma | 4.0 |
| 19 | Colorado | 3.9 |
| 20 | Massachusetts | 3.9 |
| 21 | District of Columbia[1] | 3.7 |
| 22 | Michigan | 3.6 |
| 23 | Utah | 3.5 |
| 24 | South Dakota | 3.1 |
| 25 | Arizona[1] | 3.1 |
| 26 | Kansas | 2.9 |
| 27 | Virginia | 2.8 |
| 28 | West Virginia | 2.8 |
| 29 | Illinois | 2.8 |
| 30 | South Carolina | 2.7 |
| 31 | Pennsylvania | 2.7 |
| 32 | Maryland | 2.5 |
| 33 | Mississippi | 2.2 |
| 34 | New Jersey | 2.2 |
| 35 | Texas | 2.0 |
| 36 | Florida | 1.9 |
| 37 | Missouri | 1.7 |
| 38 | Minnesota | 1.7 |
| 39 | Washington | 1.6 |
| 40 | Arkansas | 1.5 |
| 41 | Montana | 1.5 |
| 42 | Louisiana | 1.4 |
| 43 | Nevada[1] | 1.3 |
| 44 | Indiana | 1.3 |
| 45 | California | 0.3 |
| 46 | Idaho | 0.1 |
| 47 | New Mexico[1] | 0.0 |
| 48 | Wyoming[1] | 0.0 |
| 49 | Alabama | 0.0 |
|  | Average of United States | 3.3 |

[1] Less than 1,000 men of this age examined in this state.

It would seem reasonable to expect a correlation between the growth of a state by internal migration (*i. e.*, the accession of natives of other states) and its physical rating, on the ground that the most vigorous are most likely to seek their fortunes away from home. At first sight there is a correlation; of the twelve physically superior states nine gained more residents than they lost through interstate migration, and of the twelve inferior states seven lost more than they gained in the period between 1900 and 1910. The coefficient of correlation between the proportion of physical rejections, as given in Table I, and the proportion of American-born residents who were born in other states, according to the census of 1910, is −.256, with a probable

[1] R. I., Mich., and Colo.

[2] Ohio and Calif.

[3] R. I. and Mich.

error of 0.089. Moreover, if the Provost Marshall General's Final Report be studied, it is evident that interstate migration must affect the number of physical rejections to some extent, for in many of the states that lost by interstate migration the physical examinations of the eighteen-year-old class show much more favorable results, compared with other states, than those of the total draft. This is especially true of Missouri, Maryland, Virginia, Alabama, South Carolina and Louisiana. Table III gives the ratio of physical rejections in the eighteen-year-old class to the total number examined of that age, including those who volunteered after registration but not those who never registered, as that cannot be ascertained. The figures are taken from page 28 of the Final Report of the Provost Marshall General. It seems plain that there is a strong selective influence at work here, very likely strong enough to obscure the effect of foreign immigration in most states.

The results of this analysis are necessarily tentative. No satisfactory analysis can be made on the basis of the published figures. Those figures are very useful and probably sufficiently accurate for the medical man who wishes to study the frequency and geographical distribution of specific diseases and defects; but for the sociologist, who is interested in men as a whole—their size, strength, and general vigor—and in the relation between these factors and the elements of race, climate, and occupation, they are sadly deficient. On the whole, they seem to show a superiority of the native white stock over the immigrant strain; and they almost certainly show a superiority of whites over negroes. They do not support the views put forth, in Love and Davenport's report, concerning the superiority of southern agricultural whites, Indians, Mexicans, and natives of German or Scotch origin, and of rural districts in general as compared with urban; neither do they prove the inferiority of French Canadians. They are, however, consistent with Love and Davenport's conclusions as to the freedom from defect of the northern native white agricultural districts and the Scandinavian groups, and the relative excess of defects among the negroes and the mountain whites of the Appalachians. Finally, they seem to indicate that Americans living outside the state of their birth are, as the result of a selective process, physically superior to the stay-at-homes; and that, in consequence, the rapidly growing states are superior to those with more nearly stationary populations; but they do not indicate that the inferiority of the latter has developed into racial degeneracy on the part of the native whites, except possibly in some parts of Maine, Vermont, Georgia, Kentucky, and Tennessee.

# PRE-WAR UNEMPLOYMENT STATISTICS: A CRITIQUE

By Hornell Hart, *Iowa State University*

In the March (1922) number of this Journal,[1] W. A. Berridge states that "no writer on unemployment or on the business cycle has ever undertaken a rigorous quantitative analysis of the American data on unemployment." In a footnote he then refers to a monograph by the present writer, and says:

> Mr. Hart's study is comprehensive and highly laborious, but is unfortunately foredoomed to failure by the nature of the method employed. He seeks to measure the total volume of unemployment by subtracting the total "volume of employment" from the total "normal labor supply" in the United States. In both of these large quantities there are considerable errors of estimation, which of course assume a much greater relative magnitude when applied to the difference between the two quantities.

Inaccurate and misleading references such as these might well, under certain circumstances, be ignored. The monograph on *Fluctuations in Unemployment in Cities of the United States, 1902 to 1917*, has, however, been the only attempt at a quantitative study in this field, and has frequently been used by other writers as a basis for deductions. The article following Mr. Berridge's, for example, quotes its figures as authoritative. Inasmuch, therefore, as Mr. Berridge rejects the method on which those figures were based, and presents indexes of his own for the years 1903 to 1916 and 1919 to 1921 which he considers "fairly typical of industrial activity in this country" and which he believes "measure relative fluctuations in employment with high accuracy,"[2] the question of what figures should be accepted on unemployment for this period becomes worthy of attention by students of economic statistics and economic history.

In view of the fact that Mr. Berridge has put forth a "rigorous quantitative analysis of the American data on employment and unemployment," it is somewhat disconcerting to stumble upon misquotations and an incorrect reference in his footnotes, to find him using such expressions as "the coefficient of correlation was +85 per cent, 5 per cent lower than that between the two employment curves," and to note that he fails consistently to state the probable errors of his coefficients of correlation. Still more disconcerting is it to observe that in his weighted index of cycles of unemployment, which is apparently made up of deviations from trends, and which is headed "Unit:

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[1] Vol. XVIII, p. 42.

[2] *Rev. of Economic Stat.*, IV, p. 46 (Jan., 1922).

one standard deviation," the arithmetic mean of the series is +.15, and the standard deviation is .89, instead of being 0 and 1.0 respectively as one might expect. Such eccentricities make it rather difficult to put any intelligible interpretation upon the items in the index.

Technical inaccuracies are not, however, the essential objections to Mr. Berridge's pre-war unemployment index. Such errors are doubtless to be expected from inexperienced statisticians. The fundamental difficulties have to do with the essential unsoundness of his methods. In this article I shall undertake to make clear the following points:

1. Mr. Berridge's weighted index of unemployment for January, 1903, to June, 1916, correlates less closely with his own bureau's "Price Index of Business Cycles" for the same period than an index based directly upon the data used in my monograph published three and a half years earlier.
2. Correlation with any index of business cycles is not an adequate criterion of the value of an index of unemployment.
3. The elimination of seasonal variations from an employment index vitiates the index as reflecting employment conditions and is defensible only as a means of analysis. The final index should show actual fluctuations from all causes.
4. The use of the trend, as employed by Mr. Berridge, involves dangerous assumptions and leads to absurdities, which are avoided by the method used in my index.
5. The data upon which Mr. Berridge's index is based are a fundamentally biased sample, and cannot be trusted to reflect actual fluctuations of unemployment in the United States.

In January, 1922, Mr. Berridge published a table entitled "Cycles of Unemployment in All Trades and in Selected Trades in New York State, 1903–16."[1] In the discussion of that table he devoted a great deal of attention to the correlations between his index and various indexes of business prosperity. In November, 1921, his organization published "A Commodity Price Index of Business Cycles" which, the authors assert, "gives us an accurate record of the fluctuations of business and industry in general, exclusive of agriculture."[2] My monograph was published in May, 1918.[3] As one test of the relative soundness of Mr. Berridge's and my indexes, I have calculated, by the Pearson method, the correlation between Mr. Berridge's index and the deviations of the price index of business from its trend for the period covered by Mr. Berridge's index, and the correlation between my index for the same dates, in the form designated in the accompanying table as "C," and the deviations of the price index of business from its trend. The Berridge index correlates with the business index −.52 ± .04. My index correlates with the business index +.65 ± .03.

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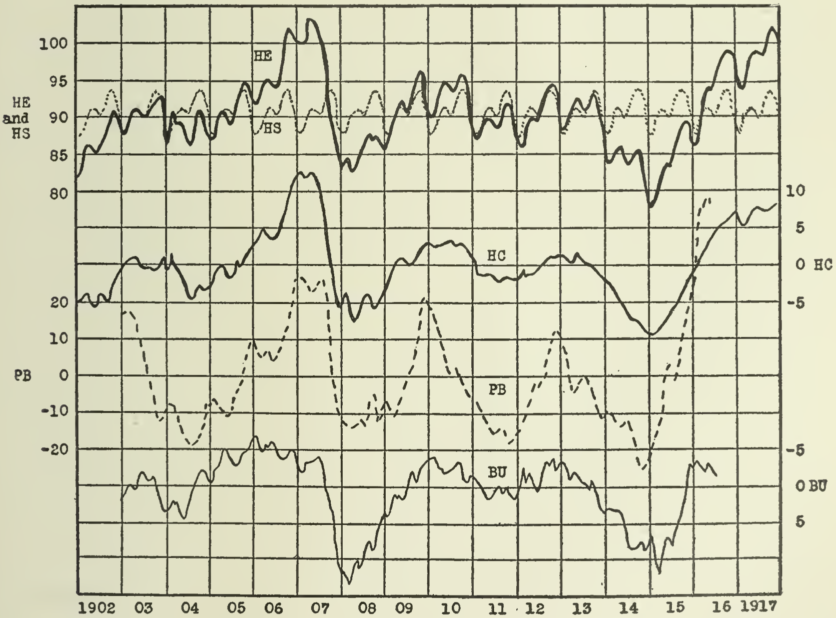
[1] *Rev. of Economic Stat.*, IV, pp. 46–49.

[2] Warren M. Persons and Eunice S. Coyle, *Rev. of Economic Stat.*, III, pp. 353–69.

[3] "Fluctuations in Unemployment in Cities of the United States, 1902 to 1917," Studies from the Helen S. Trounstine Foundation, vol. 1, pp. 47–59.

While these coefficients remove any basis for supposing that Mr. Berridge's index deserves to be substituted for data already in the field, correlation with business indexes cannot be considered an adequate criterion for judging the value of unemployment indexes. What should be sought in such an index is not a new means of measuring prosperity, but a reliable method of measuring the relative, and if possible the absolute, extent of unemployment at given dates, with a view to more accurate study of the problem, and ultimately the prediction of conditions at future dates. The number of persons unemployed is conditioned not only by the degree of general business prosperity but also by fluctuations in the supply of labor, by seasonal fluctuations in demand, by industrial disputes, and by other conditions. Prosperity and depression, moreover, act with different degrees of



NON-AGRICULTURAL PRE-WAR EMPLOYMENT AND BUSINESS CURVES

HE is Hart's percentage which the volume of non-agricultural employment constitutes of the normal labor supply. HS shows averages of HE by calendar months. HC is HE minus HS.
PB shows deviations of Pearson's Price Index of Business from its trend for the dates shown.
BU is Berridge's index of "Cycles of Unemployment" inverted.

rapidity on different employments and industries. The correlation between a perfect unemployment index and a perfect index of business prosperity would, therefore, be far less than unity. Mr. Berridge's interest in the business cycle has led him to eliminate and discard the seasonal fluctuations in his unemployment data, and he has ignored fluctuations in the supply of labor, with the result that his index does not reflect real employment conditions. The relative importance of seasonal variations may be seen in the accompanying chart.

The use of the trend by Mr. Berridge brings out a fundamental difference between his method and mine. The statistician in this field must cope with two fundamental problems: First, how he may secure reliable data on fluctuations in the volume of employment; and second, how these fluctuations may be turned into reliable measures of unemployment. In dealing with the second of these problems the United States Census of Manufactures has used the method of showing the relative numbers of persons employed in each month of the year of the census as compared with the month of maximum employment. This method ignores the facts that serious unemployment often exists in the peak month, and that population is constantly growing. A second method might be to measure deviations from a straight line drawn from peak to peak in the employment curve. This would ignore unemployment at the peaks and would make the false assumption of straight-line growth in the labor supply from peak to peak.

The solution which Mr. Berridge offers to this problem is to state his index of unemployment in terms of deviations from the trend. He seems to be under the delusion that he thereby avoids the necessity of making assumptions as to variations in the supply of labor. As a matter of fact, however, the use of the trend is in itself an assumption that the supply of labor is proportional to the ordinates of the straight line of closest fit to the curve of demand for labor. This is demonstrably untrue, and leads to absurdities. Changes in the supply of labor depend upon the birth rate, death rate, legal minimum age of employment, age of retirement from industry, immigration and emigration rates, and other factors. During the period of Mr. Berridge's index these conditions were changing at different rates, and in different directions. Migration, in particular, was fluctuating widely.

My own method of measuring unemployment was to build up a base line by means of careful estimates of changes in the supply of urban labor, and to state unemployment in terms of deviations in the demand for labor from this normal supply line. Mr. Berridge carelessly characterizes this method as "foredoomed to failure," but he does not escape the difficulty by substituting, for the supply of labor, the trend of employment as a base from which to measure deviations. He simply declines to use available knowledge to minimize error, and uses a crude base where a more exact one is available.

The absurdities to which the use of the trend lead are obvious from the fact that as new data are added the trend must constantly be altered. The trend employed in Mr. Berridge's index was valid for the period January, 1903, to June, 1914, but when he added two more years the trend did not fit. My method provides a base line which is not vitiated by the addition of subsequent data and which responds flexibly to every important change in the labor supply. Another difficulty with the trend is that it often represents factors which should be conserved instead of eliminated. There is good reason for believing that the trend in employment from 1903 to 1915 represents a real increase in unemployment; by eliminating such a trend Mr. Berridge falsifies the facts in which he is interested. Factors of this sort are conserved by the method which I used.

Mr. Persons uses a straight line trend in his price index chart of business cycles for the years 1897 to 1912, but apparently recognizes that the method is not valid for preceding and succeeding years. Indeed, the use of the trend here seems to be merely a crude and unsatisfactory method of eliminating the factor of inflation and contraction of the currency, just as Mr. Berridge's trend is a crude and unsatisfactory method of eliminating changes in the labor supply as a factor in unemployment.

Not only in the treatment but also in the selection of his data Mr. Berridge has failed to grapple adequately with the problem. His prewar index is based upon the reports of the percentages of union members unemployed, from six trades, representing "only one third or one fourth the total number of union members in New York State." In assuming that this index is "fairly representative of industrial unemployment in the country as a whole" he assumes that the returns themselves are reliable, that the unions reporting are typical of all the unions in these trades, that unemployment among union men is typical of unemployment among non-union men, that the six trades represented are typical of industry as a whole in New York State, and that New York State conditions are typical of the nation as a whole. All of these assumptions are questionable. The union men employed in railroading, for example, have entirely different employment fluctuations from the non-union men.

The data upon which my index is based include national statistics on manufacturing employment for every fifth year, national statistics on transportation, mining, and quarrying, and local data from nine representative states. It will not do to characterize this method as "comprehensive and highly laborious," and then fall back upon union reports for one class of labor in six trades in one state as a general index of unemployment. Elaborate technique is a vice unless used merely as the instrument of a worker having clear insight into the problem, for the analysis of sound and representative data.

The index of unemployment shown in the accompanying table is merely the best index yet available. It can be greatly improved, but its betterment depends upon greater comprehensiveness and thoroughness in the analysis of available data. Researches in this direction, now under way by other students, will doubtless soon supersede this index.

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The above article was written before the second installment of Mr. Berridge's article in the June number of the Journal was available.[1] In that installment Mr. Berridge has improved his previous pre-war index by adding data from Massachusetts and New Jersey, thus partially offsetting the criticism relating to the inadequacy of his basic data. It should be noted, however, that all of his materials are taken from three Atlantic coast states, and that he has still neglected important data relating to manufacturing in other sections of the country. Furthermore, although his results are labeled "General Indexes of

AN INDEX OF
NON-AGRICULTURAL EMPLOYMENT IN THE UNITED STATES
1902 TO 1917

E is the percentage which the volume of non-agricultural employment constituted of the normal supply of non-agricultural workers.
C is the deviation of E from the average of the series for that month.

| Month | Average E | 1902 | | 1903 | | 1904 | | 1905 | | 1906 | | 1907 | | 1908 | | 1909 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | E | C | E | C | E | C | E | C | E | C | E | C | E | C | E | C |
| Average... | 91 | 86 | −5 | 91 | 0 | 89 | −2 | 91 | 0 | 96 | 5 | 98 | 7 | 85 | −6 | 91 | 0 |
| January... | 87 | 82 | −5 | 87 | 0 | 86 | −1 | 87 | 0 | 91 | 4 | 100 | 13 | 83 | −4 | 85 | −2 |
| February.. | 88 | 83 | −5 | 88 | 0 | 90 | 2 | 87 | −1 | 92 | 4 | 100 | 12 | 84 | −4 | 86 | −2 |
| March .... | 89 | 85 | −4 | 90 | 1 | 89 | 0 | 88 | −1 | 94 | 5 | 101 | 12 | 84 | −5 | 89 | 0 |
| April...... | 91 | 86 | −5 | 92 | 1 | 89 | −2 | 91 | 0 | 95 | 4 | 103 | 12 | 82 | −9 | 91 | 0 |
| May...... | 91 | 85 | −6 | 91 | 0 | 89 | −2 | 90 | −1 | 95 | 4 | 103 | 12 | 84 | −7 | 92 | 1 |
| June...... | 91 | 85 | −6 | 90 | −1 | 88 | −3 | 89 | −2 | 94 | 3 | 102 | 11 | 85 | −6 | 91 | 0 |
| July...... | 90 | 86 | −4 | 90 | 0 | 86 | −4 | 90 | 0 | 94 | 4 | 101 | 11 | 86 | −4 | 91 | 1 |
| August.... | 91 | 87 | −4 | 91 | 0 | 87 | −4 | 92 | 1 | 96 | 5 | 99 | 8 | 88 | −3 | 91 | 0 |
| September | 93 | 88 | −5 | 91 | −2 | 90 | −3 | 93 | 0 | 100 | 7 | 97 | 4 | 86 | −7 | 94 | 1 |
| October ... | 94 | 91 | −3 | 92 | −2 | 91 | −3 | 94 | 0 | 102 | 8 | 93 | −1 | 87 | −7 | 96 | 2 |
| November | 93 | 90 | −3 | 93 | 0 | 89 | −4 | 94 | 1 | 101 | 8 | 89 | −4 | 87 | −6 | 95 | 2 |
| December . | 91 | 89 | −2 | 93 | 2 | 87 | −4 | 93 | 2 | 101 | 10 | 85 | −6 | 87 | −4 | 94 | 3 |

[1] "Cycles of Employment and Unemployment in the United States, 1903–14," Vol. 18, pp. 227–40.

| Month | Average E | 1910 |  | 1911 |  | 1912 |  | 1913 |  | 1914 |  | 1915 |  | 1916 |  | 1917 |  |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  | E | C | E | C | E | C | E | C | E | C | E | C | E | C | E | C |
| Average... | 91 | 93 | 2 | 89 | −2 | 90 | −1 | 91 | 0 | 84 | − 7 | 84 | −7 | 94 | 3 | 98 | 7 |
| January... | 87 | 90 | 3 | 88 | 1 | 87 | 0 | 88 | 1 | 84 | − 3 | 77 | −10 | 86 | −1 | 94 | 7 |
| February.. | 88 | 90 | 2 | 86 | −2 | 86 | −2 | 88 | 0 | 84 | − 4 | 78 | −10 | 87 | −1 | 93 | 5 |
| March..... | 89 | 92 | 3 | 88 | −1 | 88 | −1 | 90 | 1 | 84 | − 5 | 80 | − 9 | 90 | 1 | 95 | 6 |
| April...... | 91 | 93 | 2 | 89 | −2 | 89 | −2 | 91 | 0 | 86 | − 5 | 82 | − 9 | 92 | 1 | 97 | 6 |
| May...... | 91 | 94 | 3 | 90 | −1 | 90 | −1 | 92 | 1 | 86 | − 5 | 83 | − 8 | 94 | 3 | 98 | 7 |
| June...... | 91 | 94 | 3 | 89 | −2 | 90 | −1 | 91 | 0 | 85 | − 6 | 83 | − 8 | 94 | 3 | 99 | 8 |
| July...... | 90 | 93 | 3 | 88 | −2 | 90 | 0 | 91 | 1 | 83 | − 7 | 83 | − 7 | 94 | 4 | 98 | 8 |
| August.... | 91 | 94 | 3 | 89 | −2 | 91 | 0 | 91 | 0 | 83 | − 8 | 84 | − 7 | 96 | 5 | 98 | 7 |
| September | 93 | 96 | 3 | 91 | −2 | 94 | 1 | 93 | 0 | 85 | − 8 | 88 | − 5 | 98 | 5 | 100 | 7 |
| October... | 94 | 96 | 2 | 92 | −2 | 94 | 0 | 93 | −1 | 85 | − 9 | 89 | − 5 | 99 | 5 | 102 | 8 |
| November | 93 | 94 | 1 | 91 | −2 | 94 | 1 | 91 | −2 | 83 | −10 | 89 | − 4 | 99 | 6 | 101 | 8 |
| December.. | 91 | 92 | 1 | 89 | −2 | 92 | 1 | 88 | −3 | 81 | −10 | 89 | − 2 | 98 | 7 | 99 | 8 |

Unemployment in the United States," he has ignored practically all of the data relating to employment fluctuations in occupations other than manufacturing.

Other criticisms are unaffected by Mr. Berridge's second installment. His failure to take account of fluctuations in the available supply of labor, and the fact that his method is so complicated that the resulting index cannot be interpreted in common-sense terms, are serious defects. He is to be congratulated, however, upon his vigorous attack upon a vital problem, and upon having raised important questions of technique in unemployment statistics.

A reply by Dr. Berridge to Dr. Hart's criticism has been received by the Editor, but too late for publication in this issue. It will appear in the December number of the JOURNAL.

## PHYSICAL MEASURES AS FUNCTIONS OF FREQUENCY DISTRIBUTIONS

By M. C. Rorty

A point of view in connection with fundamental physical measurements which is of particular interest to the statistician arises from the very great probability that there are no absolute measures of extension, velocity, and time. Should this be the case, we are concerned, in physical mathematics, with measures which in every case must be derived from the things to be measured. If, for example, we are dealing with velocities, it is obvious that they can be measured only in relation to certain fundamental existing physical velocities. Similarly as to extension, the primary measure must be found with very great certainty in the dimensions of certain fundamental physical units.

For our present purposes it is not necessary to determine what these velocities and physical units may be. It is sufficient to know that somewhere in the physical scheme of things there must be elements of velocity and extension which are *the* most fundamental. Furthermore, with respect to such fundamental elements of velocity and extension, we can make only three assumptions: first, that all similar elements are of equal magnitude; second, that they have frequency distributions with definite modes; and third, that they have frequency distributions with no modes.

As to the preceding assumptions, it is hardly conceivable that independent elements, either of velocity or of extension, should all be equal in magnitude, in the absence of a previously existing measure by which they might be gaged. And it is almost equally difficult to conceive that they should be arranged in frequency distributions having definite modes, for the existence of such a mode would indicate a preference for some particular magnitude, which preference could hardly exhibit itself in the absence of any established standard of measurement.

If the foregoing reasoning is correct it follows that fundamental physical measures must arise out of frequency distributions having no definite modes. In such distributions the mean value is the natural measure, and the special characteristic of such distributions is that the maximum value is always almost exactly twice the mean.

To give this suggestion concrete form it may be assumed that the velocity of light represents the mean of certain primary velocities in space. On this basis the maximum primary velocity would be twice that of light. This conclusion is entirely concordant with the apparent limitation of material particles to a maximum velocity equal to that of light. In fact, there are reasons, which are, however, not pertinent to the present discussion, why material particles which are made up of a large number of ultimate primary particles should have maximum velocities nearly or exactly equal to the mean velocity of such primary particles.

An interesting feature of this approach to the problem of fundamental physical measurements is that it results in a division of physical elements into two classes. Pure time and space may be infinite, but the velocities and dimensions of material particles must be subject to measures arising out of the frequency distributions of the magnitudes involved. As to the latter, therefore, we are compelled to measure in terms of ratios. In such cases our ordinary notions of infinites become mere mathematical abstractions. The velocities of primary particles may, in one sense, have a range from zero to infinity; but, if our only measure is one half of infinity, we will, for all practical purposes, assign a value of two to the limiting velocity.

A still more interesting corollary of the hypothesis here presented is that the physicist may know when he has discovered a fundamental physical element by observing whether or not it exhibits a range of magnitudes characterized by a frequency distribution without a mode.

## ON THE CORRELATION BETWEEN A VARIABLE AND THE DEVIATION OF AN ASSOCIATED BUT NOT DEPENDENT VARIABLE FROM ITS PROBABLE VALUE

Let $r_{xy}$ be the correlation between two variables, $x$, $y$, which are so related to each other physically that $y$ may be considered a dependent variable in the special sense in which this term has been used heretofore. Pearson and I have shown[1] that

$$r_{xz} = \frac{r_{xy} - V_x/V_y}{\sqrt{1 - r_{xy}^2 + (r_{xy} - V_x/V_y)^2}}$$

where $V$ denotes the coefficient of variation of $x$ and $y$, and $z$ is to be read as the deviation of $y$ from its probable value, that is

$$z = y - px$$
$$p = \bar{y}/\bar{x}.$$

Now let $x$ and $y$ be associated with a third variable, say $w$. The correlations $r_{wx}$, $r_{wy}$, $r_{xy}$, $r_{xz}$, and the partial correlation ${}_wr_{xy}$ may be readily determined. In certain cases the correlation $r_{wz}$ and the partial correlation ${}_wr_{xz}$ may be of service.

$\bar{\bar{z}} = 0$; $\sigma_z$ may be readily determined.[2] We require, therefore, merely the product moment for $w$ and $z$. This might be determined by working directly with the individual values of the variable $z = y - px$. It is more convenient to proceed as follows:

Let $\Sigma(x)$, $\Sigma(y)$ denote the summation of the values of $x$ and $y$ for the $n$ individuals of any class of $w$. Let $S$ denote summation throughout the population or summation of the summations within the classes defined by the values of $w$.

Then within any class of $n$ individuals defined by the value of $w$

$$\Sigma(z) = \Sigma(y) - p\Sigma(x).$$

For the whole series of $N = S(n)$ individuals

$$S(wz) = S[wS(z)] = S\left\{ w[\Sigma(y) - p\Sigma(x)]\right\}.$$

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[1] Harris, "The correlation between a variable and the deviation of a dependent variable from its probable value," *Biometrika*, 6 : 438–443. 1909.

[2] Harris, "Further illustrations of the applicability of a coefficient measuring the correlation between a variable and the deviation of a dependent variable from its probable value," *Genetics*, 3 : 328–352. 1918.

Finally, remembering that $\bar{z}=0$ and expressing $r$ in terms of product moments about $0$ as origin.[1]

$$r_{wz}=\frac{S(wz)/N-\bar{w}\bar{z}}{\sigma_w\sigma_z}$$

and remembering that $\bar{z}=0$, we may write

$$r_{wz}\frac{S\left\{w[\Sigma(y)-p\Sigma(x)]\right\}/N}{\sigma_w\sigma_z}.$$

The means of arrays for testing the form of the regression curve of $z$ on $w$ are given by

$$[\Sigma(y)-p\Sigma(x)]/n.$$

J. ARTHUR HARRIS

## CALCULATION OF THE CORRELATION RATIO

The correlation coefficient $r$ is a good measure of correlation only when the regression is linear. It is necessary, therefore, before placing any reliance upon the computed $r$ to examine the data for linearity of the regression lines. One common test of linearity, Blakeman's, compares the value of $(\eta^2-r^2)$ with its probable error, $\eta$ being a correlation ratio. In applying this test it is then necessary to calculate along with $r$ the correlation ratios.

Recently the writer, with a number of assistants, among whom Mr. F. G. Wahlen should be mentioned, had occasion to compute several hundred correlation coefficients, each of which was tested by Blakeman's test. In the progress of the work, in which much use was made of the slide rule, there was developed the tabular form for the calculation of $r$ with the two correlation ratios $\eta_{yx}$ and $\eta_{xy}$, which is the content of this paper. By the addition of two columns to the tabular method of computing $r$ used by Professor H. L. Rietz, the two correlation ratios are easily computed.

This method of calculating the correlation ratios in connection with the calculation of the correlation coefficient is shown in the accompanying numerical illustration. The various columns in connection with the correlation table explain themselves in the headings, with the exception of the columns headed $S_{s'}$ and $S_s$. The column headed $S_{s'}$ is computed as follows: Let $s'$ be the number of any designated row of the correlation table, say the third row from the top. Then for that row each number is multiplied by the corresponding number in the column headed $X$. The algebraic sum of these products is $S_{s'}$. For example, for the third row from the top

$$\begin{aligned}9\cdot(-1)&=-9\\26\cdot0&=\phantom{-}0\\7\cdot1&=\phantom{-}7\\5\cdot2&=\underline{\phantom{-}10}\\&\phantom{=-}8=S_{s'}\text{ for }s'=3.\end{aligned}$$

The column headed $S_s$ is computed in a similar way.

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[1] Harris, "The arithmetic of the product moment method of calculating the coefficient of correlation." *Amer. Nat.*, 44 : 693–699. 1910.

A FORM FOR THE CALCULATION OF THE CORRELATION COEFFICIENT AND THE TWO CORRELATION RATIOS

| | | Monthly price index | | | | | $f_y$ | $Y$ | $f_y\cdot Y$ | $f_yY^2$ | $S_{s'}$ | $S_{s'}\cdot Y$ | $S_{s'}^2$ | $\frac{S_{s'}^2}{f_y}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 7.50 to 8.00 | 8.00 to 8.50 | 8.50 to 9.00 | 9.00 to 9.50 | 9.50 to 10.00 | | | | | | | | |
| Monthly pig iron tonnage | 28 to 32 | | | | 4 | 4 | 8 | 3 | 24 | 72 | 12 | 36 | 144 | 18.00 |
| | 24 to 28 | | | 4 | 16 | 1 | 21 | 2 | 42 | 84 | 18 | 36 | 324 | 15.43 |
| | 20 to 24 | | 9 | 26 | 7 | 5 | 47 | 1 | 47 | 47 | 8 | 8 | 64 | 1.36 |
| | 16 to 20 | 8 | 21 | 14 | 3 | 1 | 47 | 0 | | | −32 | | 1024 | 21.79 |
| | 12 to 16 | 10 | 8 | 2 | 2 | 1 | 23 | −1 | −23 | 23 | −24 | 24 | 576 | 25.04 |
| | 8 to 12 | 7 | 3 | | | | 10 | −2 | −20 | 40 | −17 | 34 | 289 | 28.90 |
| $f_x$ | | 25 | 41 | 46 | 32 | 12 | 156 | | 70 | 266 | | 138 | | 110.52 |
| $X$ | | −2 | −1 | 0 | 1 | 2 | | | | | | | | |
| $f_x\cdot X$ | | −50 | −41 | | 32 | 24 | −35 | | | | | | | |
| $f_x\cdot X^2$ | | 100 | 41 | | 32 | 48 | 221 | | | | | | | |
| $S_s$ | | −24 | −5 | 32 | 49 | 18 | | | | | | | | |
| $S_s\cdot X$ | | 48 | 5 | | 49 | 36 | 138 | | | | | | | |
| $S^2_s$ | | 576 | 25 | 1024 | 2401 | 324 | | | | | | | | |
| $\frac{S^2_s}{f_x}$ | | 23.04 | 0.61 | 22.26 | 75.03 | 27.00 | 147.94 | | | | | | | |

$$\overline{Y}=\frac{70}{156}=.4487$$

$$\sigma_y^2=\frac{266}{156}-\overline{Y}^2=1.5038$$

$$\sigma_y=1.2263$$

$$\overline{X}=\frac{-35}{156}=-.2244$$

$$\sigma_x^2=\frac{221}{156}-\overline{X}^2=1.3663$$

$$\sigma_x=1.1689$$

$$\frac{\Sigma X\cdot Y}{N}=\frac{138}{156}=.8846$$

$$r=\frac{1}{\sigma_x\sigma_y}\left\{\frac{\Sigma X\cdot Y}{N}-\overline{X}\cdot\overline{Y}\right\}$$

$$=.687\pm.029$$

$$\frac{\Sigma\frac{S_{s'}^2}{f_y}}{N}=\frac{110.52}{156}=.7085$$

$$\eta^2_{xy}=\frac{1}{\sigma_x^2}\left\{\frac{\Sigma\frac{S^2_{s'}}{f_y}}{N}-\overline{X}^2\right\}$$

$$\eta_{xy}=.694\pm.028$$

$$\frac{\Sigma\frac{S^2_s}{f_x}}{N}=\frac{147.94}{156}=.9483$$

$$\eta^2_{yx}=\frac{1}{\sigma_y^2}\left\{\frac{\Sigma\frac{S_s^2}{f_x}}{N}-\overline{Y}^2\right\}$$

$$\eta_{yx}=.705\pm.027$$

The theory underlying this calculation of the correlation ratios follows from an algebraic transformation of the usual expression for the ratios. The correlation ratio of the $y$ on $x$, usually represented by $\eta_{yx}$, is the ratio of the standard deviation of the means of the arrays of $y$'s (columns), to the standard deviation of the $y$'s. In the notation used in the illustration the mean of each column is given by $\frac{S_s}{f_x}$. The square of the standard deviation of the means of the columns is then

$$\frac{\Sigma f_x\left(\frac{S_s}{f_x}-\overline{Y}\right)^2}{N}$$

where $N$ is the total number of entries in the table. From the above definition of the correlation ratio of $y$ on $x$ we have

$$\eta^2{}_{yx} = \frac{\Sigma f_x\left(\frac{S_s}{f_x} - \overline{Y}\right)^2}{N\sigma_y{}^2}.$$

This form can be reduced as follows:

$$\frac{\Sigma f_x\left(\frac{S_s}{f_x} - \overline{Y}\right)^2}{N\sigma_y{}^2} = \frac{\Sigma\frac{S_s{}^2}{f_x}}{N\sigma_y{}^2} - \frac{2\overline{Y}\Sigma S_s}{N\sigma_y{}^2} + \frac{\overline{Y}^2\Sigma f_x}{N\sigma_y{}^2} = \frac{\Sigma\frac{S_s{}^2}{f_x}}{N\sigma_y{}^2} - \frac{\overline{Y}^2}{\sigma_y{}^2}$$

remembering that $\frac{\Sigma S_s}{N} = \overline{Y}$ and $\Sigma f_x = N$.

We may then write

$$\eta^2{}_{yx} = \frac{1}{\sigma_y{}^2}\left\{\frac{\Sigma\frac{S_s{}^2}{f_x}}{N} - \overline{Y}^2\right\}$$

and a similar transformation gives

$$\eta^2 = {}_{xy}\frac{1}{\sigma_x{}^2}\left\{\frac{\Sigma\frac{S_{s'}{}^2}{f_y}}{N} - \overline{X}^2\right\},$$

both of which are easily obtained from the last columns in the form for computation.

A. R. Crathorne

University of Illinois

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## NEW SWEDISH PRICE INDEX NUMBERS

The Kommerskollegium of Sweden (Bureau of Commerce) has recently completed an official price investigation undertaken at the close of the war, and the results in the form of a new series of index numbers of Swedish wholesale prices appeared in the official publication of the Kommersiella Meddelanden for May 26, 1922.

The index numbers are built on 160 series of market quotations. Approximately 105 distinct commodities are included, representing raw products and manufactured goods in various stages of elaboration both for producers' and consumers' use. The classification comprises 13 main categories; vegetable food stuffs; animal food stuffs; feed and forage; fertilizers; raw and manufactured products of the iron and metal industries; mortar, brick, cement and glass; lumber; paper and pulp; textile fibres and fabrics; hides, leather, and shoes; rubber; chemical technical products. These main classes are again divided into subordinate commodity groups. Monthly indexes are computed for each series of quotations as well as for each subdivision and general group by taking a weighted average of a percentage variation in prices. The weight used is the turnover value of the quantity marketed in 1913. The aggregate turnover value of all articles entering into the index amounts to two thirds of the total inland trade of Sweden that year. The indexes constructed for the commodity groups measure the fluctuation in monthly prices since January, 1920, in terms of the prices for the corresponding months of 1913; that is to say, January, 1921, prices are compared with the prices of January, 1913, and so on for each respective month. The field of this official inquiry is limited to wholesale prices from the beginning of 1920, and no effort has been made to cover the abnormal war period. Certain differences distinguish this index series from that of the *Svensk Handelstidning,* which reflects price movements by quarters from the beginning of the war to the end of 1917 and shows monthly fluctuations from 1918 to date. For the latter index the twelve months from July, 1913, to June, 1914, constitute the base period. The *Svensk Handelstidning* index, furthermore, is constructed from scantier material and is limited to only 47 market quotations of raw materials and slightly manufactured goods. It also weights the commodity according to value of consumption during the pre-war year instead of the value of trade turnover. In spite of these differences the degree of divergence between the two indexes is not particularly striking. The trend of movement is practically the same although the index of the Kommerskollegium is maintained consistently at a higher level.

The new price study of the Kommerskollegium is an interesting contribution to the literature of Swedish wholesale prices, especially since the compilers have published the original price material upon which the index is constructed, and have presented in detail precise market specifications of the commodities and the respective weights of all the articles included.

Another index number of current interest because of its usefulness in making international price comparisons has been compiled by the *Svensk Handelstidning* for the single month of February, 1922. The object of this publication in computing a new index was to analyze the value of the Swedish krona in relationship to other exchanges. Index numbers for the United States and England were compiled on the same basis as its own index for Sweden, using the same number and kind of commodities where possible. According to this computation the all-commodities indexes for Sweden and England are in very close agreement with each other, which points to the conclusion that, compared with 1913–14, the English pound sterling has lost approximately the same purchasing power as the Swedish krona. The index number of 132 obtained for the United States, on the other hand, gives a result widely divergent from the corresponding index of 166 for Sweden, indicating that the level of American prices in February was 34 points lower than the level of Swedish prices. As the margin is too wide to be accounted for by the slight differences in the comparability of the data, the conclusion drawn by the *Svensk Handelstidning* is that either Swedish price quotations must decline or the exchange value of the dollar rise.

Ruth E. K. Peterson

Washington, D. C.

## MISCELLANEOUS NOTES

**Volume of Employment Figures.** It will be of interest to statisticians to learn that Secretary Davis of the United States Department of Labor has recently made a ruling under which the Bureau of Labor Statistics is to have the field in the collection and publication of volume of employment figures, while the Employment Service is to collect and publish such information concerning the labor market and opportunities for employment as may be needed in the administration of its work, which is defined to be to get jobs for the jobless men.

With this jurisdictional conflict settled, Commissioner Ethelbert Stewart announces that it is the purpose of the Bureau of Labor Statistics to extend at once volume of employment data to cover several more industries and to expand greatly the number of establishments and, hence, the number of employees in the industries now included in the survey. State arrangements will be made whereever possible. An arrangement similar to that now existing between the United States Bureau of Labor Statistics and the state of New York has been practically completed with the state of Illinois, and other state agreements are under way. The Geological Survey will furnish information from the bituminous and anthracite coal mines, and the Bureau of Mines has expressed a willingness to supply similar information from the iron ore, copper, zinc, lead, silver and gold mines and from the smelting establishments. These will be individual establishment records. Railway transportation will be covered through the Interstate Commerce Commission. Immediately after the first of July the Bureau of Labor Statistics will put men in the field to form contacts with this enlarged list of establishments and industries and to complete state bureau arrangements whereever the states are willing to make a thorough canvass, and to establish a state record of volume of employment taken from the books of the establishments themselves.

It is the purpose of the Bureau to develop employment indexes by industries and a national index which will be a combination of all the industries covered. No attempt will be made to carry local indexes or indexes upon a basis of geographical areas, but assistance will be given to the states, where desired, in the compilation of state indexes from their local material. Commissioner Stewart further announces that the publication of this material will be continued as heretofore in the *Monthly Labor Review*, but that mimeographed statements of totals and indexes will be issued on or about the 5th of each month covering the payroll period as of the 15th of the preceding month.

**Public Health in Denmark.** In Danish history of public health the year 1921 is a record year, the rate of mortality being only 11 per 1,000. Out of a population of approximately 3,300,000 only 36,000 died. On the whole, public health in Denmark is standing very high. Even in the years 1918–19, when the "Spanish disease" reigned, the yearly rate of mortality was only 13 per 1,000. Danish statisticians boast that no other country has shown so low a death rate as that observed in Denmark in the past year. Still, our antipodes in New Zealand may claim a higher rank for their country, the rate of mortality being on an average only 9–10 per 1,000, the influenza year, 1918, forming a single exception with its 15 per 1,000. It may be objected that this low rate is only a crude, not a "standardized," death rate, the low mortality being ascribed to the peculiar age distribution. Using the age distribution of Sweden as a standard we will find that New Zealand has an average mortality of about 12 per 1,000, and that the Commonwealth of Australia is a little above this level.

At all events, New Zealand has a remarkable advantage in its low infant mortality rate. Danish infant mortality is also low. In 1911–15 only 10 per cent of the new-born died within one year of age; in 1919–20 the number was reduced to 9 per cent, and in 1921, even to 7½ per cent. But in New Zealand infant mortality is on an average only 5 per cent, a fact which is ascribed to such matters as climate, virility of the race, comparative absence of large industrial undertakings, and partly to legislative and educative measures. There is much stimulation for all civilized nations in these observations. It seems possible to reduce infant mortality even more, for instance, to 3–4 per cent, the harvest of death being confined only to infants born with very delicate constitutions.

Denmark has a considerable *natural increase* of population, the excess of births over deaths being in yearly average about 12 per 1,000. Before the World War about one fourth of this excess, about 7,000 yearly, emigrated; but during and after the war emigration has been greatly reduced. Since 1880 about a quarter of a million have left Denmark as oversea emigrants, the majority of them founding their new homes in the United States of America.

HARALD WESTERGAARD

**Bulletins of the U. S. Bureau of Labor Statistics.** *Occupation Hazards and Diagnostic Signs*, by Louis I. Dublin, has just appeared as Bulletin No. 306. In this publication Dr. Dublin pushed forward the studies first launched in this country through Bulletin No. 100 of the Bureau, which contains a list of industrial poisons and other substances injurious to health found in industrial processes. Numerous attempts have since been made to restate this problem in simpler and more practical terms. For a long time the Bureau of Labor Statistics has been working upon a scheme to issue occupational disease handbooks which could be carried in the vest pockets of the workers, but so far the plan has not matured. In Bulletin No. 100, it will be remembered, the poison is made the unit, the branches of the industries in which the poison occurs is more or less adequately stated together with the mode of entrance into the body, and, finally, the symptoms of the poisoning. The Ohio Bureau two or three years ago revised and restated this information making the industry the unit and indicating what poisons were to be found in the industry, the mode of entrance into the body, etc. Dr. Dublin has published the guide to the hazards of occupations and the symptoms of the diseases they cause as issued to the 6,000 medical examiners of the Metropolitan Life Insurance Company, and in these instructions we find not only that the Metropolitan Life Insurance Company has gone beyond the mere list of poisons but has called attention to the health hazards from working conditions such as dampness, extreme dry heat, sudden variations of temperature, and inorganic dust. It is a brief but very valuable contribution to the practical side of the subject.

*The Problem of Dust Phthisis in the Granite-Stone Industry,* by Frederick L. Hoffman, appears as Bulletin No. 293. This report is without doubt Dr. Hoffman's ablest, most thorough and comprehensive publication relating to a single industry.

*Industrial Unemployment: A Statistical Study of Its Extent and Causes,* by Ernest S. Bradford, will be issued as Bulletin No. 310. Dr. Bradford's volume will be a handy reference to sources of information and to information that has already been published.

**Nordisk Statistisk Tidskrift.** Under this title a new Scandinavian statistical journal has been founded by the Swedish statistician, Thor Anderson. It may be doubted whether twelve million Swedes, Norwegians, and Danes are a sufficient basis for a journal with such a comparatively narrow program; but the editor has very wisely procured as contributors renowned statisticians of other countries. Thus, in the first number of the journal appear very interesting articles by Professor Tschuprow and Professor L. v. Bortkiewicz. On the whole, this first number is very promising, dealing as it does with various important problems of practical and theoretical value. H. W.

**Labor and Industry.** This is the name of a new monthly publication issued by the Department of Labor and Industry of Pennsylvania. It is the official organ of the department and is edited by Mr. S. P. Hollingsworth. The publication contains reports of the activities of the various bureaus in the department and presents data collected from time to time concerning the status of labor and industry.

**Public Health Work.** A continuous series of canvasses is being made by field assistants of the Statistical Office, U. S. Public Health Service, of approximately 2,000 typical families in Hagerstown, Md., for the purpose of recording the incidence and prevalence of ill health in a representative population group for at least a year. The canvass was begun in November, 1921, and is being carried on in conjunction with the Washington County Health Demonstration, which is conducted under the auspices of the Johns Hopkins School of Hygiene and Public Health, the Maryland State Board of Health, and other agencies. The records for the canvassed population of between 8,000 and 9,000 persons include family economic status, home and community sanitary conditions, and nativity, sex, age, and other facts regarding each individual.

At the annual meeting of the American Association of Industrial Physicians and Surgeons held at St. Louis, May 22–23, a committee was appointed to cooperate with the Statistical Office of the U. S. Public Health Service in securing records in industrial plants of disabilities by cause among employees classified according to nativity, sex, age, and occupation, and according to physical status as determined by physical examinations. Dr. R. S. Quinby, of the Hood Rubber Company, Watertown, Mass., is chairman of the committee.

**Committee on Educational and Professional Standards for Statisticians.** This Committee, appointed by the Board of Directors of the Association in November, 1921, to consider educational and professional standards for statisticians, is preparing a preliminary report for the attention of the Association at its annual meeting next December. The Committee has been in correspondence with a number of representative statisticians here and abroad, and finds a general current of opinion in favor of a statement on educational fundamentals. In the preparation of the preliminary statement the opinion of these statisticians will be carefully considered.

Mr. Ethelbert Stewart, U. S. Commissioner of Labor Statistics, was invited by the University of Chicago to deliver a series of three lectures on how a great governmental statistical investigation is handled. Mr. Stewart delivered the lectures in May, describing step by step the methods and processes of a statistical investigation.

Dr. John Rice Miner, Associate in the Department of Biometry and Vital Statistics of the School of Hygiene at Johns Hopkins University, has been granted leave of absence for the next academic year, and will spend the time in study and travel abroad. During Dr. Miner's absence his position will be filled by Dr. Flora D. Sutton, who has for some time been connected with the Department in one capacity or another.

Dr. F. Stuart Chapin has resigned his position as Professor of Sociology at Smith College to become Professor of Sociology and Chairman of the Department of Sociology at the University of Minnesota. Dr. Chapin takes up his new duties in September.

Dr. F. H. Hankins, formerly Professor of Sociology at Clark University, has resigned his position at Clark to become Professor of Sociology and head of the department at Smith College.

Dr. Raymond Pearl's series of Lowell Lectures on Biology of Death will shortly be published in revised and extended form as a book, by the J. B. Lippincott Company in its series of Monographs in Experimental Biology.

Dr. Lowell J. Reid, Associate Professor of Biometry and Vital Statistics in the School of Hygiene and Public Health, Johns Hopkins University, has been appointed consultant in biometry and vital statistics in the U. S. Public Health Service.

Dr. H. R. Bonner, statistician of the Bureau of Education, Department of the Interior, Washington, D. C., has resigned his position to take up on September 1 the duties of Director of Educational Research with the American Alcohol Education Association.

Miss Margaret G. Myers, of the Statistical and Research Bureau of the Federal Reserve Bank of New York, was granted a leave of absence for the summer and taught in the Bryn Mawr Summer School.

Miss Katharine Snodgrass, who has recently resigned from the Division of Analysis and Research of the Federal Reserve Board, since their offices have been moved to Washington, has accepted a position with the newly organized statistics department of the Chemical National Bank.

In response to numerous requests, the Pollak Foundation for Economic Research has reprinted from the *Atlantic Monthly* for February, 1922, an article by Waddill Catchings entitled, "Our Common Enterprise: One Way Out for Labor and Capital." Copies may be obtained upon application to the Pollak Foundation, Newton 58, Massachusetts.

The President of the Association has appointed the Nominating Committee to nominate officers for 1923, to be considered and voted upon at the annual meeting in December, as follows: Carroll W. Doten, Chairman, Willford I. King, George P. Watkins.

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## MEMBERS ELECTED SINCE MAY

Alexander, Carter, Asst. director of the Educational Finance Inquiry, 525 W. 120th St., New York City
Arnold, Herbert E., Wesleyan University, Middletown, Conn.
Bedinger, George R., Director, Health Service Dept., American Red Cross, New York County Chapter, New York City
Blakely, David N., Medical director, New England Mutual Life Ins. Co., Boston, Mass.
Boyd, George A., Bell Telephone Securities Co., 195 Broadway, New York City
Bristow, Helen G., Sugar Statistics, Lamborn & Co., New York City
Brunner, Edmund de S., Director, Town and Country Dept., Committee on Social and Religious Surveys, New York City
Clark, Evans, Labor Bureau Inc., New York City
Cothran, James R., Consulting actuary, Atlanta, Ga.
Cox, Emily M., Sugar Statistics, Lamborn & Co., New York City
Craster, Charles Vaughn, Dept. of Health, Newark, N. J.
Dochterman, Elsie F., Statistical Dept., Metropolitan Life Ins. Co., New York City
Emerson, Haven, Professor of Public Health Administration, College of Physicians and Surgeons, Columbia University, New York City
Emmons, Lloyd C., Michigan Agricultural College, East Lansing, Mich.
Fried, Orrin A., Statistical Dept., Industrial Commission, Madison, Wis.
Frost, Eliott, Director, Industrial Management Council, Chamber of Commerce, Rochester, N. Y.
Gould, Charles W., Cost accountant, L. L. Brown Paper Co., Adams, Mass.
Hall, William DePuy, Actuarial Dept., Mutual Trust Life Ins. Co., Chicago, Ill.
Haynes, Williams, Publisher of *Drug & Chemical Markets*, New York City
Hemenway, Earl L., President's Office, Michigan Agricultural College, East Lansing, Mich.
Hendrick, Augustus C., 50 Buchanan Place, New York City
Jaquith, Walter A., Vice-president and medical director, National Life Ins. Co., Chicago, Ill.
Jacobs, Philip P., Publicity director, National Tuberculosis Ass'n, New York City

Kirk, Carl L., Asst. statistician, Zurich General Accident and Liability Ins. Co., Chicago, Ill.

Klein, Julius, Director, Bureau of Foreign and Domestic Commerce, Washington, D. C.

Koerner, Carl C., Statistician, Weyerhaeuser Sales Co., Spokane, Wash.

Lescohier, D. D., Dept. of Economics, University of Wisconsin, Madison, Wis.

Long, John C., Secretary, Educational Dept., National Automobile Chamber of Commerce, 366 Madison Ave., New York City

Lonigan, Mary E., Dept. of Labor, Albany, N. Y.

Loudon, Robert C., Curtice Brothers Co., Rochester, N. Y.

Luedtke, Charles L., Research and Foreign Statistics Section, Dept. of Agriculture, Washington, D. C.

Miller, Walter McNab, Executive secretary, Missouri Tuberculosis Ass'n, St. Louis, Mo.

Myers, Margaret G., Federal Reserve Bank, New York City

Nott, Richard A., American Tel. & Tel. Co., 195 Broadway, New York City

Pearson, Oscar P., Statistician, Nat'l Automobile Chamber of Commerce, 366 Madison Ave., New York City

Pranke, Edward J., Commercial Research, American Cyanamid Co., New York City

Redpath, John M., Manager, Research Dept., Chamber of Commerce of U. S., Mills Bldg., Washington, D. C.

Riddle, J. H., Chief, Section of Statistics, Treasury Dept., Washington, D. C.

Rogers, Homer L., Civil engineer, Conservancy Bldg., Dayton, Ohio

Rubins, Marian, Graduate student, University of Minnesota, Minneapolis, Minn.

Schafer, Irving J., Manager, Statistical Dept., Westinghouse Lamp Co., Bloomfield, N. J.

Smith, Donald B., Harvard Graduate School of Business Administration, Cambridge, Mass.

Smith, R. Gilman, Statistician, North American Co., New York City

Vose, Harold P., American International Corp., 120 Broadway, New York City

Warne, Frank J., Wage consultant, 302 Mills Bldg., Washington, D. C.

Watson, John C., Statistician, Illinois Agricultural Association, Chicago, Ill.

Will, H. S., Director, Bureau of Public Research and Service, Toledo University, Toledo, Ohio

Williams, Helen J., Lincoln National Life Ins. Co., Fort Wayne, Ind.

Wright, Francis A., Certified public accountant, 515 Republic Bldg., Kansas City, Mo.

# REVIEWS

*Costs, Merchandising Practices, Advertising and Sales in the Retail Distribution of Clothing,* by Northwestern University School of Commerce Bureau of Business Research, Horace Secrist, Director. New York: Prentice-Hall, Inc. 1921. 6 vols. 622 pp.

Much information of value to the consumer, to the retail clothing merchant, and to the student concerning the items of expense and merchandising practices in the selling at retail of men's clothing is revealed in the six volume report of the Northwestern University School of Commerce Bureau of Business Research, of which Professor Horace Secrist is director. This is the first study to be published of the retail distribution of clothing.

The inquiry was made in coöperation with the National Association of Retail Clothiers and included the years 1914, 1918, and 1919. Questionnaires were sent to all of the members of the association and replies were received from 569 stores, about 10 per cent of the total association membership. Not all of these stores reported on all items included in the questionnaire, which covered in much detail all aspects of the retail clothing business except profits. To utilize to the utmost the data received, Professor Secrist has considered separately each portion of the questionnaire relating to a particular item. He has taken, for example, rent, and has tabulated the data from all stores reporting on this item regardless of whether or not they reported on other items in the schedule. Thus, 415 stores reported on total sales in 1919, although the number of stores giving information on other important items was somewhat less.

Analysis of the data for 1919 showed an average expense of $2.20 per $100 of net sales for rent; $11.93 for wages and salaries; $5.16 for "general expense," which included expenditures for light, heat and power, depreciation, local and state taxes (but not federal taxes), interest and borrowed money, bad debts charged off, etc.; $1.98 for advertising; and $21.49 for total expense.

The report is not confined to an analysis of cost information, but deals also with such matters as sales per unit of floor space, number and value of suits sold, sales of furnishings in proportion to clothing, returned goods and charge sales, purchases in relation to inventory, stock turnover, mediums of advertising used, and building and equipment of retail clothing stores.

The purpose of this inquiry was in the main a very practical one. The aim was to establish, for the guidance of retail clothing establishments, on the basis of the data collected, "standards of excellence by which merchants and others may know whether costs are excessive or merchandising practices sound." The question arises whether the statistical method employed in analyzing the data is the best one for the purposes of the study made. Is the standard or norm which is to serve as a guide for retail merchants to be the experience which is the most common, *i. e.*, the mode, or that of the most efficient operating establishment, or the arithmetical average of the stores reporting?

Professor Secrist has answered this question by placing all or practically all of the emphasis on the average in his statistical analysis. In the discussion of the item of rent, for example, there are 35 tables of which only two are frequency tables. Similarly, in the discussion of wage and salary expense there are 33 tables giving averages only, and but two frequency tables. In the summary discussion at the beginning of the volume relating to rent, wages and salaries, the discussion of conclusions is based wholly on the average figures. It is true that in the introduction the author calls attention to the value of other statistical devices in analyzing data. After stating that the data relating to amounts of expenditures and the relations which they bear to sales may be used in full confidence, Professor Secrist states that "this study . . . is a study of statistical frequencies with which given relations between items of expense and the conditions determining them are encountered. Such a method of study develops the average, the common and the extreme conditions which prevail."

The admirable method of study thus outlined is not, however, adhered to. Although the study includes 1918 and 1914 experience as well as 1919, the few frequency tables given in the discussion of rent, general expense, wages and salaries, and total expense refer only to 1919. There are no figures other than average figures given for either 1918 or 1914 concerning these items. Moreover, it is highly questionable whether the average figures for 1919 are representative of the data. Considering first the four main items of store expense—rent, wages and salaries, general expense, advertising—in no instance does the mode correspond to the average, and only in the case of one item, wages, does the average fall within the second largest group of frequencies. In the case of "total expense" the average reported is $21.49. Of the 399 stores reporting total expense in 1919, the total expense reported by 141 stores falls in the grouping $15 to $20, and 231 stores (59 per cent) report less than $20.

The figures for 1919 are as follows:

| Item of expense | Number of stores reporting | Expense per $100 of net sales | | | |
|---|---|---|---|---|---|
| | | Average | Mode | Second largest group of frequencies | Median |
| Rent | 393 | $2.20 | 94 at $1.00–$1.50 | 88 at $1.50–$2.00 | 220 under $2.00 |
| Wages and salaries | 378 | 11.93 | 103 at 7.50–10.00 | 90 at 10.00–12.50 | 261 under 12.50 |
| General expense | 351 | 5.16 | 69 at 3.00– 4.00 | 58 at 4.00– 5.00 | 216 under 5.00 |
| Advertising | 367 | 1.98 | 90 at .50– 1.00 | 85 at 1.00– 1.50 | 205 under 1.50 |
| Total expense | 399 | 21.49 | 141 at 15.00–20.00 | 93 at 20.00–25.00 | 231 under 20.00 |

In the summary to Volume III in the discussion of the item of total expense no mention is made except of average figures, and the discrepancy between the average figures and the common experience of retail clothing establishments is not noted. The comment on tables 81 and 82, which give the frequency distribution of stores reporting classified amounts of total expense per $100 of net sales, is as follows: "Table 81 is introduced to support the average figures shown in table 78. Just how accurate is the average total expense per hundred dollars of total net sales for each of the group of stores as given in table 78, is revealed in the details of table 81." The entire discussion of the frequency table occupies less than half a page, and it is hardly probable that even the most enterprising retail merchant would disregard the conclusions of the conveniently placed summary and the ten pages of discussion placing emphasis on the average as the standard and substitute the different conclusions which would be made from an analysis of the frequency tables. The treatment of other frequency tables is similar to that of table 81.

In addition to compiling the average expense for various items from reports received from all stores reporting on that item for any particular year, Professor Secrist submits separately the average expense for identical stores which reported for all three years. In general, it may be stated that the averages for identical stores lead to the same conclusions as those based upon the figures for all stores from which reports were received. An error seems to have been made, however, in noting the number of stores reporting for 1914. For example, it is stated on page 107 that only 229 stores reported on rent for 1914. Yet on page 108 it is stated in table 3 that 268 identical stores reported on rent for all three years — 1914, 1918, and 1919. A similar error is made in the discussion of wages and salaries, general expense and advertising. The number of "identical stores" reporting for all three years is greater than the number of all the stores reporting similar data for 1914, although in the latter group are included stores reporting for 1914 but not for other years.

One very important matter not treated at all in the report is that of profit. In this as well as in other respects the report differs from the Harvard studies on retail businesses. However, it is possible in a general way to determine selling margins and profits from facts already made available by the Department of Commerce in its study of the Men's Clothing Industry in 1915, and from the data in the present report. In its report on the Men's Clothing Industry, the Department of Commerce tabulated the retail selling price and the wholesale price of some 144 suits of clothing manufactured by establishments under investigation. The relation between net wholesale price and retail price varied considerably in the case of various models. However, in the case of 79 out of the 144, the net wholesale price represented between 60 and 65 per cent of the retail price. The net wholesale price was less than 60 per cent of the retail price for 25 cases and in 40 instances over 65 per cent of the retail price. In more than two thirds of the cases falling within the group of 60 per cent but less than 65

RELATION OF NET WHOLESALE PRICE TO RETAIL PRICE OF MEN'S CLOTHING FEBRUARY, 1915

(Based upon the report of U. S. Department of Commerce, "The Men's Factory-Made Clothing Industry," Misc. Series No. 34, pp. 89–92)

| Number of suit styles | Per cent the net wholesale price was of "usual retail price" |
|---|---|
| 10 | Under 57.5 |
| 15 | 57.5 but under 60 |
| 55 | 60 " " 62.5 |
| 24 | 62.5 " " 65 |
| 25 | 65.0 " " 67.5 |
| 15 | 67.5 or over |
| Total 144 | |

per cent the net wholesale price was less than 62½ per cent of the retail price. It might therefore be considered that in general the net wholesale price was approximately 62½ per cent of the retail price. The selling margin, then, early in 1915, was approximately 37½ per cent of the retail price.

When comparison is made between merchandising expense in 1914 and in 1919 it is observed at once that in 1919 every item of expense was lower than in 1914. In 1914 the total expense averaged $24.56 out of every $100 of net sales. In 1919 the average was $21.49.

AVERAGE EXPENSE PER $100 OF NET SALES FOR RENT, WAGES AND SALARIES, GENERAL EXPENSE, BUSHELING, ADVERTISING, TOTAL EXPENSE, 1919, 1918, 1914

| Average | Rent | Wages and salaries | General expense | Busheling | Advertising | Total expense |
|---|---|---|---|---|---|---|
| 1919 | $2.20 | $11.93 | $5.16 | $2.57 | $1.98 | $21.49 |
| 1918 | 2.89 | 13.14 | 5.85 | 2.77 | 2.04 | 23.69 |
| 1914 | 3.57 | 12.91 | 5.68 | 2.76 | 2.51 | 24.56 |

The mode for total expense in 1919 was between $15 and $20 per $100 of net sales. No figure is given for the most common experience for the total expense for 1914, but on the basis of the average figures for total expense and for each item of expense, it is clear that merchandising expense in 1919 was much less than in 1914 per $100 of net sales.

If we assume that the selling margin in 1914 was 37½ per cent and that the total expense was roughly 25 per cent on the average, the net profit was roughly 12½ per cent of net sales.

Selling margins during the year 1919 when prices were rising were undoubtedly fully as large as they were in 1914, yet much was said about the higher expenses of the retailers—rent, wages, general expense—as being at least in part the cause of higher prices. The figures of Professor Secrist, however, show distinctly that in every item of expense the proportionate cost of doing business was less in 1919 than it was in 1918 or in 1914. In fact, the cost of doing business in 1919 was less by 12½ per cent than it was in 1914. The effect upon net profits was undoubtedly even greater.

H. K. Herwitz

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*Prices and Wages; An Investigation of the Dynamic Forces in Social Economics*, by Percy Wallis and Albert Wallis. London: P. S. King and Son. 1921. 449 pp.

The authors have devoted this large book to an attempt to prove a single economic proposition, namely, that the average price of commodities is determined by the labor time involved in their production relative to the labor time involved in the production of gold in which their price is measured. This theory is an old one and is the chief part of the Marxian doctrine, but the present book attempts an advance in two important respects, first, in offering a new explanation of the means by which the employer abstracts from the price of goods the part which goes to capital and land; second, in the extent to which statistical data are relied upon for the confirmation of the theory. Both of these innovations are within the field of interest of the readers of this Journal.

After an examination of the statistics of national income in the United States and England the authors conclude that 64 per cent of the total national income goes to labor. How do the employers manage to retain 36 per cent of the price of goods? The authors argue that the force which makes possible any subtraction for interest, capital, and employer's services is unemployment. If there were no unemployment the laborers would get it all; if all were unemployed the employers would get it all. If it be assumed that each percentage of unemployment gives an equal increase in the percentage of profit, it follows that the 64 per cent going to labor is the result of 36 per cent of unemployment. The statistics of unemployment do not admit, however, of the supposition that unemployment averages as much as 36 per cent, and the authors, therefore, reject the hypothesis that the division of the product is determined by a straight line between the points of no employment and no unemployment. From the available data they estimate that the average unemployment, allowing for part-time employment, in the United States and England is 12.5 per cent, and conclude that this amount of unemployment results in the division of product already indicated. A parabolic curve is drawn through this point (*i.e.*, 12.5 per cent unemployment and 64 per cent wages) and the points of origin, and it is contended that this curve gives the formula for the division of the product. It appears that if unemployment were 50 per cent, the employer would get 70.7 per cent of the product, but only, of course, 35.3 per cent of the possible maximum which would be produced if all were working. The employer would get the maximum in goods if unemployment were kept at 31 per cent, in which case he would get 38.4 per cent of the maximum product.

Is there any support for the view that the share going to labor fluctuates in such a manner as to conform in any degree to the curve here given, or even at all with unemployment? Certainly the figures for the distribution of national income are not available in the necessary serial form to compare with fluctuations in the unemployment rate. The authors do give some data as to changes in wages in certain English industries in periods of unemployment, which on the basis of the violent assumptions made bear some correspondence to the curve. It does not appear to have occurred to the authors that even a very marked relationship over a very limited part of the curve between unemployment and changes in the percentage going to labor and the employer would still leave the question open as to whether the present distribution is the result of unemployment. Against that hypothesis we have the outstanding fact that the percentage going to the laborer varies enormously from industry to industry. Certainly these variations bear no relationship to the amounts of unemployment in these industries.

If we turn now to the second attempted advance, namely, the proof by statistical data that labor time governs price, the outcome is equally disappointing. The authors have calculated for a number of commodities the "normal price" for a series of years, "normal price" being defined as the number of articles produced per person multiplied by the money price. According to the labor-time theory the normal price would remain the same if there were no changes in the cost of gold. The proof of the theory would, therefore, consist in showing (1) that changes in the normal prices of different commodities were consilient and (2) that these changes were in agreement with the changes in the per capita output of gold. The authors have been able to find only a few commodities for which the normal price can be calculated, since the number of persons employed, the market price, and the number of units produced are necessary for the calculation. But the normal prices of coal have been calculated for several European countries. The correspondence in the fluctuations of these normal prices is marked, and all the curves show a gradual rise from 1860 to 1910. The fluctuations in general correspond, as might be expected, with changes in the ordinary index numbers of prices. The general rise in the normal prices of coal, which the authors make much of as indicating that the fall in general prices during the forty years from 1860 to 1902 shown by the ordinary index numbers of prices is erroneous, was due to the facts that wages rose in all European countries and that the per capita production of coal did not increase in anything like the same degree as that of manufactured commodities. When the authors approach the second and crucial question of the correspondence of the normal prices of these commodities with the quantity of gold produced per person, they are occupied chiefly in offering explanations of the failure of the normal value of gold to agree with the normal price of other commodities.

An enormous amount of labor has gone to the making of this book, and it is an ungrateful duty for a reviewer to have to say that in his opinion it has been wholly wasted.

George E. Barnett

The Johns Hopkins University

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*Wealth and Income of the American People: A Survey of the Economic Consequences of the War*, by Walter Renton Ingalls. York, Pa.: G. H. Merlin Company. 1922. xiv, 321 pp.

The main title of this book is likely to convey the idea that it parallels or duplicates the recent report of the National Bureau of Economic Research. That impression is erroneous. Though the author sometimes makes use of the material of the Bureau, his method and especially his purposes are different. In fact, the book contains a greater number and more general judgments and convictions than are quite appropriate for a statistical work. But the statistics used are, on the whole, dealt with critically and objectively. The author's economic opinions are less well considered, and indeed often appear to be hasty and cock-sure. Mr. Ingalls is an engineer.

The chapters of especial statistical interest are: II, "The Production of Commodities," 22 pages; III, "Wealth of the United States (the External Position)," 38 pages; and IV, "Wealth of the United States (the Internal Position)," 82 pages. The remaining chapters, though usually quantitative in thought, are seldom statistical in content. The special feature of the method of the book is its inventory of the nation's capital so largely on the basis of corporate financial data.

Mr. Ingalls seeks to prove that the country was not better off in 1920 than in 1916. The thesis is worthy of careful consideration and practically important as a corrective of much unthinking self-deception of the public on this subject. If the statistics are not all that could be desired, and if quantitative conclusions are often rather forced, it is not so much the fault of the author as it is the lack of adequate data. It would be better if fuller or more exact references to sources had been given so that a later worker on the same subject might more easily rebuild and extend the statistical structure.

The author's most important conclusions may be summed up in his own words: "The physical volume of production during the eight years beginning with 1913 and ending with 1920 increased no more than commensurately with the increase in population" (p. 281). "From the end of 1916 to the end of 1920 the physical wealth of the United States increased from 268 billion dollars to 272 billion as an outside figure" (p. 282).

The attempt to avoid the effects of price inflation upon the estimates is entirely commendable. The writing-off of surplus plant is an interesting and important detail, even if, as done, it is open to criticism as perhaps being too drastic. Any statistician attempting to inventory our capital would greatly profit by following the figures and analysis presented in this book.

The author says in his preface: "An underlying thought in my work in this book is a repudiation of the quantitative theory of money" (p. viii). Since its advocates and opponents mean different things by this term, we cannot be quite sure from this statement what is meant. One who accepts the quantity theory can quite as readily agree with the author's numerical conclusions as one who does not. If a test is whether we are going back to pre-war prices, indications in the middle of 1922 are not the same as they appeared in the middle of 1921.

Remarks about the benefit to statistics of "the entry of professional men into this field" (p. 272 *et. seq.*) may be interpreted to mean that statistics are concrete, not abstract, numbers, and that the statistician cannot know too much about the facts underlying his figures.

The book is somewhat journalistic in tone, if the word may be used to imply no lack of industry and only some degree of lack of critical finish and proportion. Some of the conventional prejudices of the business world find uncalled-for expression. There is sometimes a lack of appreciation of developments that do not appear to be thoroughly understood—as of the theory of business cycles (p. 279) and of index numbers (p. 204). But the book is worthy of serious attention from statisticians and others interested in its subject.

G. P. Watkins

Washington, D. C.

*Income in the United States, Its Amount and Distribution, 1909–19.* By the Staff of the National Bureau of Economic Research, Incorporated: Wesley C. Mitchell, Willford I. King, Frederick R. Macauley, Oswald W. Knauth. New York: Harcourt, Brace and Company. 1921. xvi, 152 pp.

The worth of this little volume is two-fold. As a positive contribution it ranks with the best that American economic scholarship is producing. As an exhibit of scientific method it is an exhilerating stimulus to inductive investigation. The group of gifted young scholars—King, Macaulay, and Knauth—whom Professor Mitchell has gathered about him and infected with something of his own enthusiasm and fidelity, not only have shown what success can attend quantitative investigation into "subjects that affect public welfare," but have given new proof that economic knowledge proceeds by the hard road of laborious inquiry rather than by the alluring ease of speculative theorizing. It was by no accident that the preliminary report of one phase of the inquiry—Mr. Macaulay's paper read at the Pittsburgh meeting of American economists and statisticians—should have been accorded little short of an ovation by the company that heard it. Fine scholarship, painstaking toil, technical competence, literally hall-marked the performance, and the fraternity was prompt in acclaiming a *tour de force.*

Although it is this general quality of the essay, even more than its statistical technique or its positive contributions, that constitutes its chief appeal, the specific results are impressive. In the matter of the aggregate income of the American people, its variation from year to year and the causes of that variation, the division of the aggregate income among individuals, the proportions of the whole income going to wage earners and salaried employees, and the per capita income in the United States as compared with other countries, a base line has been drawn, perhaps not definitive, but certainly the necessary starting point for all succeeding discussion of these and related subjects. Pareto's "law" is interred, decently but with finality; the fact that there is a larger per capita income in the United States than in other countries is established, and the detailed distribution of personal incomes is reduced to a working statistical basis. A second volume, now in course of publication, will discuss the sources utilized and the methods employed, and it is proposed to continue the work of estimating the national income from year to year on a comparable basis as the necessary data become available.

Finally, something should be said as to the literary style and formal plan of the book. It is written in clear simple English, with a modesty in statement and a restraint in criticism that leave the edge undulled. As to arrangement, in its economy and directness it suggests nothing so much as the monition of a great teacher: "Have something to say, say it, sit down."

Jacob H. Hollander

The Johns Hopkins University

*Facing Old Age: A Study of Old Age Dependency in the United States and Old Age Pensions*, by Abraham Epstein. New York: Alfred A. Knopf. 1922. 352 pp.

The author's first sentence reads as follows: "This book is, frankly, an appeal for social action." Following the foreword, in which he states that "our present methods in dealing with the aged are antiquated, inefficient, ineffective, costly and demoralizing," he presents arguments and a volume of reference material in support of the establishment of an old age pension system in the United States.

The book is divided into five parts and an appendix. The first part deals with the actual condition of the aged and pictures the modern industrial worker as in a very difficult position with respect to his approaching old age. Data are presented to show that the present unfavorable condition is becoming progressively more serious. The following quotations indicate that the author apparently has no sympathy with modern industrial and medical progress:

> Increased industrial efficiency, "scientific management," the "bonus system," and specialized and standardized production are forces which are increasingly using up human energy at greater speed and in a briefer period of life. Often, at the age when the worker in agricultural pursuits is considered to be in his prime, the industrial worker is found to have become worn out and old. . . . The lot of the aged and superannuated worker is thus adversely affected by practically every step of industrial progress; and little or no benefit is derived by old wage-earners from industrial improvements.
>
> . . . one cannot but wonder whether the fact that the aged population in the United States has increased from 3.5 per cent for those 65 years of age and upward in 1880 to 4.3 per cent in 1910, and that the expectation of life has improved, has been a desirable thing and is to be considered much of a blessing by the aged poor. Faced with conditions such as described above, and with the almshouse as the final destination of a life of destitution and drudgery, do they not look upon modern industrial development, as well as the advances made in medical progress and health as the creations of an evil spirit, which have, on the one hand, curtailed their period of production, and, on the other hand, prolonged their years of misery by the increased duration of life?

Part II of the book takes up the causes of old age dependency. Here the author first charges superannuation, dependency due to waning earning power, lack of family connections, sickness and industrial accidents as individual causes of dependency. He presents data compiled from various sources on sickness and accidents, and ends with the following charge against industrial efficiency:

> It is out of place to dwell here upon the tremendous price which is being paid annually in human and economic values in this country, largely as a sacrifice to greed and greater efficiency. . . . What this annual hecatomb means in terms of destitution and mental and physical suffering to the victims and their dependents permits no estimation.

The inadequacy of the wages paid to the wage-earner is presented next as an important cause of old age dependency, and he points out that "rarely is it taken into consideration by either party to the labor contract in modern society that the basis of the daily wage must make provision for such exigencies as sickness, accident, disability and old age." Finally, unemployment, strikes, general misfortunes, and the part played by moral character are included in the causes of old age dependency.

Part III treats of existing methods of relief and presents a description of the various individual savings plans open to the wage-earner and of the various staff pension funds of industrial and governmental organizations. The author points out that the inadequancy of these plans is due to the facts that they have not been generally adopted, that many of those already adopted are subject to discontinuance at any time, and that many of them are financially unsound.

Part IV describes the purposes and nature of old age pensions and presents arguments for and against various methods of financing them. A history of the pension movement in this country is then given.

Part V describes the old age pension schemes and funds of other countries and of various states of this country, including approximately thirty different plans.

Although no specific outline of a general old age pension plan is recommended in the book, the appendix includes the draft of a bill introduced in the United States Congress to provide old age pensions, and the draft of a bill proposed by the Pennsylvania Commission, of which the author was director, and introduced in the Pennsylvania legislature in 1921.

The bill presented to the Pennsylvania legislature provides for the creation of a State Old Age Assistance Board consisting of three members appointed by the governor. This board is to appoint a State Old Age Assistance Superintendent, who is to be provided with assistants. In each county of the state a county board of three citizens, appointed by the governor (with the approval of the state board) on the recommendation of the county commissioners, is also provided for. County boards may appoint local investigators and make recommendations to the state board. An old age pension is to be fixed in each case by the state board, but in no case shall it exceed $25 a month. To qualify for a pension the applicant must be a citizen of the United States, he must have attained the age of sixty-five and have been a resident of Pennsylvania for 15 continuous years immediately preceding his application, or for 35 years followed by 5 continuous years immediately preceding his application. He must not be an inmate of any jail, asylum, poorhouse or similar public institution, he must not have an income in excess of $300 a year, nor property valued in excess of $5000, and he must not have a child financially able to support him. The applicant whose claim is approved receives a certificate showing the amount of his pension, which certificate is subject to cancellation or change in the event of a change in the applicant's income. On the death of the applicant any amounts paid under the certificate, with 3 per cent interest, are deductible from his property and refundable to the state. If he has no property the state pays burial expenses not exceeding $100. No reserves are created, no contributions are required, no actuarial estimates or checks are provided. The entire cost of the pensions is to be provided by the Commonwealth of Pennsylvania. The administrative expenses of the state board are to be paid by the state, and the expenses of the county boards by the counties.

The author pleads guilty to a certain bias in connection with his presentation of the subject, but he attempts to present the material regarding the various systems of old age pensions impartially. He has endeavored to give such a complete presentation of the workers' condition and has drawn upon so many sources that the data included must be used with care; otherwise the reader will find some disagreement between the arguments and the figures presented. It is to be regretted that the author does not present any estimates of the probable future cost of the various types of old age pension plans. In view of the difficulties that are confronting so many pension schemes which have been established without proper regard to cost, it would seem that the relative costs of the various old age pension plans proposed should receive careful consideration before laws are placed on the statute books.

George B. Buck

*Index Numbers of Wholesale Prices in the United States and Foreign Countries*. U. S. Department of Labor, Bureau of Labor Statistics. Bulletin No. 284 (revision of Bulletin No. 173). October, 1921. 350 pp.

The monograph on index numbers of wholesale prices, prepared under the direction of Dr. W. C. Mitchell and first published in July, 1915, is so well known to all who have occasion to use or to analyze index numbers or to construct new ones that any review which concerns itself with the contents of the original study would be entirely unnecessary. In the present edition, Part I, entitled, "The Making and Use of Index Numbers," has been revised, and Part II, on "Index Numbers of Wholesale Prices," has been brought down more nearly to date. These changes, however, have not introduced any material modification of the content or method of the earlier bulletin. There have been included in this edition the index numbers prepared by the Federal Reserve Board, which were begun subsequent to the original publication of the monograph, and some of the more recent work on the index numbers of foreign countries. Doubtless for some good and sufficient reason no reference has been made to certain of the inquiries into index numbers or to a good deal of index number discussion that has been in progress abroad since the close of the war. The earlier monograph was already so thorough in its method that it has not been necessary to make very far-reaching changes. The most important change is perhaps a more extensive mathematical treatment of certain of the phases of index number computation. This no doubt is of large interest to the more technical student of the index number problem, particularly in so far as discussion is offered of the war price literature.

In Part II where the various existing index numbers are reviewed, nothing materially new is given, but what is furnished is brought down sufficiently close to date to make the monograph once more the most complete and available handbook on the subject that is within reach of the student. In the present edition a few of the more important new index numbers are discussed in addition to the ones covered in the original study. Since many of those in the earlier study have long been discontinued, however, it would seem that greater service might have been rendered if some of these had been eliminated and others which are in very general use at the present time had been included.

It is to be regretted that this most recent volume does not undertake to enter the field of recent international price discussion or to review the various methods that have been developed in the last few years for comparing the prices of different countries whose currencies are not upon the same metallic basis.

H. Parker Willis

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*Immigration and Labor*, by Isaac A. Hourwich. New York: B. W. Huebsch, Inc. Second Edition, Revised, 1922. xxxii, 574 pp.

The first edition of *Immigration and Labor* appeared in 1912. It followed the publication of the report of the Immigration Commission, appointed in 1907, which had unanimously recommended some form of restriction of immigration. Dr. Hourwich's work was principally an attempt to refute the conclusions of the Commission. For this purpose he was indefatigable in the collection of statistics and insisted that the problems connected with immigration had to be viewed in the light of the concrete facts rather than of abstract theory or mere prejudice. The first edition met with severe criticism at the hands of two competent reviewers, Professor Fairchild and Dr. Foerster, whose principal fire was directed against Dr. Hourwich's unscientific and injudicious, not to say deliberately misleading, use of the statistical method.

The main body of the present revised edition is, with the exception of a few minor changes, the same as the first edition. The text is the same, and no more recent statistics have been added. This edition, however, contains an additional chapter on "The Lessons of the War," and in the appendix there is a section in answer to Professor Fairchild and Dr. Foerster, the critics of the first edition.

With the strictures of Dr. Hourwich's critics upon his employment of the statistical method, the present reviewer finds himself in cordial agreement. Again and again the author assumes that what is *cum hoc* or *post hoc* is also *propter hoc*. If wages are higher in certain states having large immigration than in others having a small number of foreign-born, or if wages are higher in cities with their large proportion of foreign-born than in rural districts with small foreign-born population, it is proved, concludes the author, that immigration has no harmful effect upon wages. Or again, if the ratio of trade union membership to urban population is greater in New York than in Kansas although the former state has a far larger proportion of foreign-born in its population, it is proved that immigration is not an obstacle to the organization of labor. The author seems to be unconscious of the fact that other factors besides immigration may possibly affect wage rates or the organization of labor.

Dr. Hourwich maintains that our experience during the World War, when immigration was reduced to a very low level, was a vindication of his contentions concerning the effect of immigration upon wages. The war period was one of increasing physical volume of production and of enlarged profits for employers. Here was the opportunity, he says, to determine by actual experiment the effect of restriction of immigration upon wages. What was the outcome? He points out that wage statistics are in an unsatisfactory state and that there are conflicting opinions concerning the course of real wages during the war, but he considers that the principal evidence shows a decline. He concludes that "if restriction of immigration is to become the permanent policy of the United States, our recent war experience does not warrant the assumption that the resulting scarcity of labor will inure to the benefit of the American wage worker." Dr. Hourwich should also have stated, however, that this same experience does not disprove the assumption. It is in just such a problem as this that statistical investigation must be supplemented by economic analysis. Only upon the assumption that everything but immigration remained the same would it be justifiable to conclude that the statistical showing of the movement of real wages during the war disproved the theory that restriction of immigration would inure to the benefit of the American wage worker. There were changes in too many factors besides immigration, however, to warrant such a conclusion. Consider, for instance, the change in the value of our monetary standard due to inflation of currency and credit. It is well known that at such times increases in money wages tend to lag behind those in prices of commodities, which would mean an increase in profits at the expense of real wages. Bear in mind also the fact that the country was waging a war involving expenditures of gigantic proportions, and that all that was spent for guns, munitions, aeroplanes, battleships, and for the replacement of torpedoed merchant vessels, was so much withdrawn from the real income and real wages of the nation. Total production may have increased, as the statistics of Day and Stewart quoted by Dr. Hourwich seem to indicate; but a large proportion of this production, consumed in the waging of war, was of no avail toward augmenting the real wages of workers, in the sense of goods and services for their own consumption. Hence decreases in real wages were to be expected both because of changes in distribution and because of the probable decrease in the total product available for distribution. The fact, then, that the decrease in wages happened to come at the same time as a restricted volume of immigration proves nothing as to the causal relations between the two.

It is Dr. Hourwich's professed purpose to treat the problem of immigration from the economic viewpoint. But, as a matter of fact, he never gets at the heart of the economics of immigration. That problem involves the following questions: (1) Has the population of this country reached such a point that its natural resources are employed to the best advantage, and that further increases in population must mean working under less and less advantageous conditions as regards natural resources, with a consequent decline in the marginal productivity of labor? (2) Regardless of the answer to the above question, does increased immigration mean an unbalanced growth in our population, that is, such an enlargement of the group of unskilled laborers as to increase the inequality in the distribution of wealth and to hinder the process of abolishing poverty? (3) Granted that the immigrants may be better off in this country than in their old homes and also that the upper classes of native-born workers may reap certain material benefits through the presence of a plentiful supply of cheap unskilled labor, is it still true that the continuing existence of a large group of underpaid, poorly housed, insufficiently nourished human beings constitutes a sore spot in the body politic, encouraging ill-considered demands for sweeping changes in our economic system while the fundamental cause of the poverty of the unskilled, namely, the excessive number of them, is ignored? Looked at in this way the question of immigration involves a probing of the very foundations of economic science, an analysis, on the one hand, of the relationship between population and natural resources and, on the other hand, of the whole problem of distribution. Such an analysis Dr. Hourwich did not attempt. If he had, he must have been more circumspect in the drawing of conclusions from the statistics which he gathered.

William O. Weyforth

The Johns Hopkins University

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*The Census and Some of Its Uses: Outlining a Plain Philosophy of Population,* by George T. Bisset-Smith. Edinburgh: W. Green & Son, Ltd. 1921. 228 pp.

The title of this book seems to promise three things: some account of the census, mention of some of its uses, and an outline of a plain philosophy of population. One may logically, therefore, consider the content of the book with reference to these three subjects, although the arrangement of the material is such that it would be difficult to segregate and bring together those portions which relate to any one topic. To be sure, the book is divided into three parts, but in subject matter the parts do not apparently differ from one another; and as for the chapters, it would seem as if almost any accidental order would be just as logical as that in which they appear. One reason for this formal defect may be found in the fact that the book is in part a reproduction of articles upon various aspects of the census which the author "had contributed to the press from time to time in his limited leisure." It seems fairly evident that many such articles have been reproduced as chapters without any alterations.

On the subject of the English census the book contains considerable information. Having been for many years connected with the Department of the Registrar General for Scotland the author is familiar with census taking in Great Britain. There are only casual references to the census in other countries. The British Census Act of 1920 is given in an appendix, the census questions are discussed in different connections, and some of the difficulties of census taking are dwelt upon. But there is no connected or complete account of the organization and machinery of census taking, and hardly any reference to the tabulation and presentation of the census data.

As a census man I have frequently thought that the uses of the census presented an important and timely subject which has not received adequate treatment. The public, I am afraid, is inclined to be sceptical. So when I received this book I took it up eagerly, believing that here the uses of the census, or at least some of them, would be convincingly set forth; but the author has hardly more than touched upon that subject. Yet the uses of the census are neither few nor unimportant.

The "plain philosophy of population" is equally hard to find and formulate. Under such titles as "industry and socialism," "unemployment," "fertility of marriage," "Bolshevism," and "German militarism," the author expresses his views regarding many social and economic questions. He dissents emphatically from the doctrine that population increases faster than subsistence. Having faith in the "illimitable power of human invention and resource," he denounces the doctrine of over population as a bogey raised by Malthus, and repeatedly declares that "no country can continue powerful without a progressive population." This would seem to be the fundamental tenet in his philosophy of population.

The most valuable and interesting portions of this book, as already intimated, are those which relate to the English census; and the author might have forestalled criticism to some extent if he had adopted some title less pretentious and more appropriate, such as "Informal Talks on the Census and Other Subjects."

J. A. Hill

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*The Economics of Petroleum,* by Joseph E. Pogue. New York: John Wiley & Sons, 1921. 375 pp.

Mr. Joseph E. Pogue's latest book, "The Economics of Petroleum," deserves appraisal from three points of view.

It merits a place as a source book in the neglected field of the economics of production and marketing. The author does not deal with labor problems; his only reference to labor is labor cost. He has little or nothing to say of monopoly, combination, regulation, or the Sherman and Clayton acts, and he makes only incidental reference to finance, investment and profits. He places emphasis rather on the supply and demand for petroleum and its multiple products; on the commercial interaction of oil and the other fuels; and on the machinery of production, transportation, and marketing. His analysis of these subjects is able and comprehensive. It is a study of the kind that we need to develop a theory of production.

To the executives of the petroleum business the book should have an even stronger appeal. It is the first comprehensive picture of the industry that combines a consideration of engineering and economics. The analysis is dynamic rather than static. It searches for trends and finds many of them—trends of markets, of prices, of reserves and demand. American petroleum is considered in its relation to the world supply, and oil is viewed as in competition with coal, oil shale, gas, and water power. The market for by-products and the competitive pressure of substitutes are examined. Changes in the future supply of motor fuel are correlated with necessary changes in the engines that use it. The basic material on these varied topics the author has selected from many sources and has examined critically in the light of his own experience as geologist and consulting engineer. To cover so wide a field requires boldness in interpreting and in projecting trends, and the technicians will doubtless take exception to some of Mr. Pogue's conclusions; but it is just this courageous projecting of tendencies that business needs in a troubled time like the present, and the fuel industry owes Mr. Pogue a debt of thanks for undertaking it. Probably no other man in the country could do the job so well.

The book is also interesting because of its statistical technique. Text, tabular matter, and diagrams are woven into an organic whole. To economize the attention of the reader, quantities are expressed in large units—millions of barrels, thousands of dollars, etc.—not only in the text itself but also in formal tables. How many of Mr. Pogue's readers will correctly interpret the logarithmic charts that he uses to show rates of change may be open to question; but he has taken every precaution to prevent misunderstanding, including an ingenious marginal "sale of increase or decrease." Indeed, the standard of execution of all the diagrams is high, and there are many of them. As a presentation of quantitative data the book is notably successful.

F. G. Tryon

U. S. Geological Survey

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*History of the Great War Based on Official Documents.* Medical Service General History, Volume I. London: His Majesty's Stationary Office. 1921. 463 pp.

This is the first of four volumes on the general history of the British medical service, and is a part of the series giving a more detailed history of the war from the medical and surgical standpoints. This volume relates in narrative form the chief features of the medical service from 1914 to 1918 in the United Kingdom in garrison overseas and with expeditionary forces. The other three volumes of the series will deal with the medical service in France, Italy, the Mediterranean area, Mesopotamia, Aden, East Africa, and Russia.

There is a brief summary of the growth of the Royal Army Medical Corps before the World War, and its subsequent expansion. An account of the training of the medical staff, its duties, administration, and the handling of supplies and equipment from 1914 through demobilization is given in detail. It is pointed out that the medical service expanded rather by accretion than by preconceived plan. There is a brief summary of the medical service in West and Southwest Africa and in Tsingtau. There is also a full account of some of the more important problems which the R. A. M. C. encountered, especially in reference to the medical examination of recruits, the sanitary arrangements for billeting, and the demobilization of the doctors. This impartial explanation answers the criticism which was so common during the war and which arose from the failure to understand the problems involved. The reader of the volume will get an intelligent grasp of the problems connected with the R. A. M. C.; and for those who wish to go into greater detail there are tables and summaries in the Appendix giving information relative to the quantity of supplies and equipment and of the accommodations for the wounded.

Margaret Gantt Stephens

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*A First Course in Statistics*, by D. Caradog Jones. London: G. Bell & Sons, Ltd. 1921. 286 pp.

This book is adapted for use as a text by students who have previously covered an elementary treatise on the subject. True, it begins with a review of fundamental principles, but the treatment is so brief and the discussion so meager that it is not well suited to beginners in the field.

The weak side of this work is that it analyzes only in an incomplete way many of the reasons for the adoption of certain processes or methods. In this respect it is sharply contrasted with Armand Julin's recent work on *Principes de Statistique Théorique et Appliquée.* The strong feature of the book under review is that it gives a rather simple and, in some cases, an exceptionally well worked out presentation of the methods involved in such processes as correlation, sampling, and curve fitting. The volume will doubtless prove to be one of the best available texts in statistics for students who have mastered elementary calculus and have a mathematical turn of mind.

WILLFORD I. KING

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# THE MEASUREMENT OF DIFFERENCES BETWEEN VARIABLE QUANTITIES

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In biological statistics it is often necessary to study the differences between two variable types. The problem may be exemplified by a consideration of the differences between the types represented by populations of various countries, as, for instance, between the populations of Sweden, Switzerland, and Central Africa. It is obvious that the type of Sweden differs less from that of Switzerland than the latter differs from the type of Central Africa. Nevertheless, it is difficult to say just what is meant by greater or lesser difference in type. The attempt to establish and describe varieties of races according to characteristic features that are considered as significant from a morphological point of view, suffers, therefore, from a lack of clarity of concept.

The differences between the averages of types have been utilized for the purpose of segregating subtypes of human races, as, for instance, in the classification of the local types into which the European race may be divided. Pigmentation, stature, form of hair, head, face, and nose have been so utilized. For example, local types have been described by Deniker [1] by assigning to each group peoples among whom certain average values of measurements are found. All those that have average statures, head indices, facial forms, nose forms, and pigmentation falling within certain limits that may be expressed numerically, were assigned by him to a certain subrace. Although it is possible to give in this manner a definite description of local types, the biological significance of the observed differences remains undetermined. Obviously the classification obtained by the method here indicated will vary according to the limits which we set for each division. If we call tall those populations whose average stature is more than 170 cm., their assignment to a subdivision will not be the same as the one obtained when we call those tall whose average stature is more than 172 cm. If no valid reason can be given for the choice of one or the other limit, then the subtype so established can have a conventional descriptive meaning only. If we wish to establish a biologically significant classification we should have to prove that the descriptive features selected are morphologically significant. Furthermore, it would be necessary to distinguish between environmental and hereditary influences that determine the particular features which are made the basis of the classification. As a matter of fact, this study has never been made; and since the lines of demarcation between classes are arbitrary, these classes will be only a convenient schematic review of the distribution of certain selected combinations of descriptive features.[1]

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[1] *The Races of Man.*

In the following pages I wish to discuss the question whether a valid method of comparing closely allied forms can be found, so that arbitrary classifications may be avoided and measurable differences between types established.

It may seem that maps showing the distribution of a single feature or of combined features would give this information. Retzius' maps of Sweden, Livi's maps of Italy, Virchow's map of hair color in Germany, anthropological maps of France, England, and Spain, all illustrate the distribution of forms of the body, either by showing the areas in which the same average value of a measurement occurs, or areas in which certain selected values occur with equal frequency. The maps are intended to convey the impression that sameness of average values or of frequencies indicate the occurrence of the same racial forms. They also indicate that the differences between types are equivalent whenever the differences between averages or between frequencies of occurrence of selected values are the same. This has often led to the interpretation that the values whose frequency is shown represent separate racial types. Thus, the frequency of long-headedness in an area is often said to mean that a long-headed race forms a certain proportion of the population, although no biological basis can be given for the claim that the arbitrarily selected values represent a separate racial type.

The essential difficulty of our problem may be made clearer by the following considerations. Each racial type is variable. When we study the distribution of any particular feature, let us say of the cephalic index among European types, we find that the forms which occur in each area are variable, and the individuals composing the populations of different areas show in part the same numerical values of the measurement. The distribution of forms in each population is such that the types overlap. The average cephalic index in Sweden may be 77; in Bavaria 85. Nevertheless, there will be many individuals that have the index 81, both in Bavaria and in Sweden; and according to this particular feature individuals may belong to either group. We know that if two regions are not too far apart, it is quite impossible to assign with certainty a single individual to either of them.

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[1] See also St. Poniatowski, *Ueber den Wert der Index Klassifikation*, Archiv. für Anthropologie, N. F. Vol. 10, p. 1.

If we assume for the moment that the variability found both in Sweden and in Bavaria were very low, so that the highest cephalic index occurring among Swedes would be not more than 80 and the lowest occurring in Bavaria not less than 82, then the two series would appear to us entirely distinct. It would be quite inadmissible to claim that the differences between the two pairs of groups were the same in the cases of greater variability (which has actually been observed) and the lesser variability (which has here been assumed), although in both cases the averages show the same differences. In the latter case we judge that the difference is greater, or perhaps better, more fundamental.

Obviously our judgment is influenced by the degree of variability, still more, by the degree of overlapping of the two series. Only if we assume quite arbitrarily that the individuals that show the average values of the measurement in question—or some other selected value—were the true representatives of the whole population, and that all others were present only as foreign, intrusive elements, or if their occurrence represented modifications of the typical form due to extraneous causes—only under these conditions could we say that the difference between the selected values represents the difference between the types. A concept of variability like the one involved in these assumptions is, however, quite inadmissible. The group must be considered as a *class* and its variability be determined by the definition of the class in question. Our detailed study of the class will always be directed toward the discovery of new principles of classification by means of which subclasses are formed whose variability will be less than that of the original class. In this way we try to define the newly formed subclasses more sharply than the original class, and the advance in our knowledge consists in the discovery of the factors that make the subclasses more determinate. It would be quite arbitrary to select one particular individual as the type, and to claim either that all others are not really members of the class or that they are modified forms of the type. This method of procedure would contravene the fundamental concept of variability, for a variable comprises *all* the representatives of a class, the individual components of which are only defined in so far as they are members of the class—this in contradistinction to constants which are assumed to be completely defined and must therefore be the same in every case.

As soon as these principles are held clearly in mind, it appears that the ordinary definition of arithmetical difference is not applicable in our case. The term "difference" as applied to variables does not mean the same as the term "difference" applied to constants. Variables cannot be brought into a measurable series by the same means that we use for constants which may be compared by means of an arbitrary standard that is also constant.

The problem before us is how to overcome these difficulties—how to give a definite meaning to the differences between variables and make these differences measurable.

The question has been treated by G. H. Mollison [1] and by J. Czekanowski.[2] Mollison has discussed particularly the problem of differences between two types, and he gives an arbitrary formula which later on was modified by St. Poniatowski,[3] according to whom the difference

$$D=(a_1-a_2)\ \frac{\sigma_1+\sigma_2}{\sigma_1\ \sigma_2}.$$

In this formula the distance between the two averages is expressed as a multiple of the two values of $\sigma$, and, as a measure of the distance, is assumed the value $\frac{\sigma_1\sigma_2}{\sigma_1+\sigma_2}$. The problem, however, can hardly be solved by such arbitrary methods.

In the following pages I shall discuss some possible approaches to the problem.

What we call difference in this case is not by any means an arithmetical difference; it is a judgment of the degree of dissimilarity of two series. If two series are so far apart that notwithstanding their variability they do not overlap, they are entirely dissimilar. If they do overlap they will be the more dissimilar, the less the amount of overlapping. In this sense we may say that two pairs of series in which the amount and character of overlapping are equal will be equally dissimilar. While we may thus determine equality of dissimilarity we are not in a position to determine quantitatively the degrees of dissimilarity.

In treating this problem we may first of all explain the meaning of similarity and dissimilarity by means of a few examples. Let us assume that a pure negro and a pure white population are to be compared. The types are so distinct in all their features that in comparing them we should emphasize simply their dissimilarities. Now let us assume that a third community is added, consisting perhaps of baboons. It appears at once that our point of view would be shifted from a consideration of dissimilarities between negroes and whites to the similarities which they have in common as compared with the baboon, and their similarities will appear to us now under a new angle and as of different value.

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[1] *Morphologisches Jahrbuch*, Vol. 42, p. 79.

[2] *Korrespondenz-Blatt der Deutschen anthropologischen Gesellschaft*, Vol. 40.

[3] *Archiv für Anthropologie*, N. F. Vol. X, p. 274.

When we compare a group of blond, blue-eyed North Europeans with dark complexioned, brown-eyed South Europeans, their dissimilarities are the most striking feature. If we add a negro community to these two groups, the similarities between the North and South Europeans would be much more prominently in our minds. We may observe the same changing attitude when we speak of family resemblances, or similarities. When we consider the children of a family, entirely by themselves, without any reference to any other family, they will appear to us as dissimilar. If the family has a particular characteristic feature, let us say, for instance, a long narrow nose, which all the children have to a greater or less extent, this will become the feature which makes them similar as compared to the rest of the population.

It is, therefore, clear that the concept of the degree of similarity depends upon the characteristics of all the groups that are under consideration and will change with the groups that are being compared.

In investigations on heredity it has been customary to determine the degree of similarity by means of the coefficient of correlation. When, for instance, parents and offspring are compared, the coefficient of correlation between the two will indicate the degree of their similarity. There is a biological relation between parent and offspring. The average form of the offspring is determined by the degree to which the parent differs from the average of the population to which he belongs. In marriage we may have selective mating through which the forms of two parents may be correlated. When the husband differs from the average of the population by a certain amount his wife will differ by a correlated amount. In both of these cases there is a functional relation between the two values. The distinguishing feature of fraternal correlation is that we are dealing with a natural group in which there is no true functional relation whatever. In a very large fraternity the bodily form of one member does not influence in any way either the average body form of the rest of the fraternity or the distribution of the individual forms. The fundamental equation [1] of correlation

$$[y] = qx.$$

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[1] Brackets indicate averaging.

has no meaning in this case because the coefficient of regression $q$ will approximate zero—the more so the larger the fraternity. This is due to the fact that the members of the fraternity are all members of the same variable class, while in all the other cases previously noted we are dealing with relations between different classes. Fraternal correlation originates only in a population in which the fraternities represent different types. If all the families had the same average value there would be no correlation and no similarity between brothers. The greater the heterogeneity of the population, the greater will be the correlation and similarity between members of a fraternity. If we call the coefficient of fraternal correlation $r$, the deviation of individuals from the average of the whole series $x$, the deviation of the family average from the general average of the population $d$, then for families of $n$ children,

$$\left[\left(\frac{x_1+x_2+x_3+\ .\ \ .\ \ .+x_n}{n}\right)^2\right]=[d^2]. \tag{1}$$

If the standard deviation of all the values of $d$ is $s$ and the standard deviation of all the values of $x$ is $\sigma$, then it follows from (1) that

$$\sigma^2\left(\frac{1+\overline{n-1}\,r}{n}\right)=s^2 \tag{2}$$

and for a very large number of $n$,

$$r=\frac{s^2}{\sigma^2}.$$

When all the families are alike, $s$ is zero, and therefore $r$ is also zero. The greater is $s$, that is the greater the diversity of family types, the larger is $r$.

If we assume the variabilities of the fraternities to be the same for all families and to be expressed by $s_1$, then for large numbers of $n$,

$$\sigma^2=s^2+s_1{}^2$$

and

$$r=\frac{1}{1+\frac{s_1{}^2}{s^2}}.$$

Exactly the same considerations may be made for racial types. A local variety may be considered as a fraternal group. The term $r$ will then be a measure of the heterogeneity of the people or of the dissimilarity of the groups.[1]

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[1] In another place ("On the Varieties of Lines of Descent Represented in a Population," *American Anthropologist*, NS. Vol. 18, pp. 1–9), I have shown how the heterogeneity of a population may be determined according to this method even in those cases in which each fraternity consists of a small number of individuals, and I have given a number of examples of heterogeneous and homogeneous

Thus we are led again to the conclusion that similarity has a meaning only when we consider a group as a whole, and that it is not possible to employ the terms "similarity" or "dissimilarity" in such a way that they have the same meaning for all combinations of groups. I have calculated, according to the formula just given, on the basis of Livi's data, the heterogeneity of the Italian population with regard to their cephalic index and find it to be 0.34, while it is only 0.12 for the Italian population north of the Appenines.

It does not seem that we can obtain in this manner a satisfactory measure for differences in the degree of similarity between single groups.

The problem of the definition of similarities has been treated fully in experimental psychology. Weber's law is actually an expression of the observation that the differences between two pairs of sensations are judged to be equal. In this case the basis of empirical determination of similarity is the probability of mistaking one difference for another. It is not, as was originally assumed, a measure of quantitative value of the sensation itself. This concept of similarity holds good not only in the case of simple sensations but also in the field of more complex experience. We may speak of similarity, or of the probability of failing to differentiate, for the most diverse kinds and the most complex forms of mental experience. The problem that we are discussing here has suggested itself in every comparative study of mental processes.

In an analogous manner we may define the degree of similarity as the probability of mistaking an individual that belongs to one group for a member of any of the other groups concerned. The degree of dissimilarity may then be determined by the probability of recognizing an individual as belonging to his own group.

If we call $p_1$, the probability of occurrence of a certain measurable

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populations. It may be remarked here that in a mixed population for which no information as to descent is available, heterogeneity will ordinarily appear when the measurements of two organs are correlated. If various families represent different types with regard to two measurements which are not correlated; if the averages of these types have deviations $d$ and $d'$ from the general average, and if the individuals deviate from the respective averages of their families by the amounts $x$ and $y$, then their correlation may be expressed by

$$r = \frac{[(d+x)\ (d'+y)]}{\sigma x \cdot \sigma y},$$

and since $x$ and $y$ are assumed not to be correlated

$$r = \frac{dd'}{\sigma x \cdot \sigma y}.$$

Calculating in this way the correlation between cephalic index and stature for the whole of Italy on the basis of Livi's data, we find a correlation of +.1, while in a homogeneous series the correlation between stature and cephalic index is negative. The value +.1 is derived from observations of 300,000 individuals, and is therefore quite certain.

I have discussed this phenomenon in relation to the population of Paris in the *American Anthropologist*, NS. Vol. 1, pp. 448-61.

form $X$, which is a member of a certain variable class; $p_2$ the probability of occurrence of the same form $X$ as a member of a second class, etc.; if, furthermore, $n$ such classes occur in which the observation $X$ has the probabilities of occurrence $p_1, p_2, p_3 \quad . \quad . \quad . \quad p_n$ and if the probabilities of occurrence of the classes are $p_1', p_2', p_3' \quad . \quad . \quad . \quad p_n'$, then the probability of occurrence of the form $X$ as a member of the series $r$ is $p_r p_r'$; and the total probability that any individual of measure $X$ will occur in the aggregate of $n$ series will be

$$p_1p_1'+p_2p_2'+p_3p_3'+ \quad . \quad . \quad . \quad +p_np_n'.$$

The probability that a certain value $X$ among all the values of $X$ belongs to the series $r$ is therefore

$$\frac{p_r p_r'}{\Sigma pp'}.$$

Now let us assume that there be given $n$ individuals of the form $X$ whose provenience is not known, but who actually belong to the series $r$. If our knowledge of the aggregate is perfect, then the $n$ given individuals must be assigned according to the principle that among $n$ assignments $\frac{p_r p_r'}{\Sigma pp'}n$ must belong to the series $r$, the rest to the series *not* $r$. The probability of a correct assignment of a single observation is therefore

$$\frac{p_r p_r'}{\Sigma pp'}.$$

If, now, a series of observations of the class $r$ is given, the probability of the occurrence of $X$ in this series will be $p_r$.

Then, under the conditions just mentioned, the probability of the occurrence and at the same time of the correct assignment of $X$ to the class $r$ will be

$$P_{x,r}=\frac{p_r^2\, p_r'}{\Sigma p\ p'}. \tag{3}$$

The probability that any one of all the values of $X$ that do occur is correctly assigned, is therefore

$$P_r=\int_{-\infty}^{+\infty}\frac{p_r^2\, p_r'}{\Sigma p\ p'}dx, \tag{4}$$

and we may call this the degree of dissimilarity between the series $r$ and the aggregate of all the series that are being considered. It is obvious that in this manner the degrees of diversity for all the other individual series may be established, that they may be subtracted from one another, and that in this manner differences in the degree of similarity may be determined.

It may be pointed out that when three series are compared in this manner in pairs, the resultant values are not additive. If only series (1) and series (2), then series (1) and (3), then series (2) and (3) are considered, the sum of the difference between (1) and (2) plus that between (2) and (3) will not be equal to the difference between (1) and (3). This is another expression of the observation made before that the meaning of similarity changes with the aggregate of the series that is being considered.

It might also seem possible to arrange the single series in the order of their averages and to determine their dissimilarities step by step. Here the difficulty may arise that two succeeding averages may be nearly the same, while their variabilities may be quite different. Whenever this occurs quite an erroneous impression of the differences would be given. The reason for this difficulty lies in the fact that the difference as here defined depends upon the averages and variabilities of the single series, and that certain combinations of these result in the same degree of dissimilarity.

In the case treated here the various series enter into the aggregate according to the number of individuals representing each series. It might be, for instance, that a large mass of material has been accumulated for one group and that another group is known through the study of a very few individuals only. Our expression contains, therefore, a weighting according to number which obscures the more general theoretical question. If the groups were known perfectly, then all would have equal weight, *i. e.*, we should have to assume them to be represented by equal numbers. All the values $p'$ would then be equal. This is the assumed condition under which most comparisons of types are actually made. We have, then,

$$P = \int_{-\infty}^{+\infty} \frac{p_r^2}{\Sigma p} dx \tag{5}$$

as a measure of dissimilarity and

$$P_1 = 1 - \int_{-\infty}^{+\infty} \frac{p_r^2}{\Sigma p} dx \tag{5*}$$

as a measure of similarity.

Whether equation (5) or equation (4) represents the conditions of a set of observations, or whether a form with still different weighting should be selected, depends upon the clarity of our concept of the characteristics of each group. If we assume each group as thoroughly studied and therefore known in all its characteristics, then equation (5) will represent the conditions adequately. On the other hand, if we are impressed by the unclassified series as a whole, without detailed study of each group, and if we try to determine the similarities and dissimilarities on this basis, then formula (4) will correspond to the conditions of the investigation. If subjective elements are to be eliminated as far as possible, we must try to adjust conditions so that equation (5) can be applied. As a matter of fact, our judgment of similarity in all cases of this type is fluctuating; sometimes one group, sometimes another, is most prominently in our minds, and the actual assignments are therefore different from the two extreme forms (4) and (5) discussed before and may lie somewhere in between, or they may change with changing mental conditions. The more thorough our knowledge of each series, the closer will be the approach to form (5).

The formulas here given present the inconvenience that the values obtained for similarity are the smaller, the larger the number of series forming the aggregate, so that when the number of similar series is very great the values of their similarities will be exceedingly small.

In the final results it may appear that some of these series have the same degree of dissimilarity. If the averages and variabilities of these series are also indicative of identity, the series should be combined.

It must be remembered that it is possible for a number of different distributions to result in the same amount of dissimilarity. Since every distribution depends at least upon two constants, average and standard deviation, there are whole sets of functions which will give us the same value for the total probability of mistaking a member of one series for a member of the rest of the aggregate. However, owing to the general likeness of forms of distribution, the occurrence of this event is improbable. On the other hand, dissimilarity can occur only when distributions are unlike. The minimum amount of dissimilarity is found when all the series are identical. If there are $n$ series, the value of dissimilarity will be $\frac{1}{n}$.

All the dissimilarities have necessarily positive values. For this reason if one dissimilarity consists in the prevalence of high values, another one in the prevalence of low values, they ought to be distinguished, and the direction of dissimilarity may be indicated by opposite signs. It will, therefore, be necessary in every case to consult also the characteristic averages and distributions in order to give the proper sign to the values of dissimilarity. It must, however, be understood that the values are additive only without regard to the sign, since they all represent probabilities.

I have calculated on the basis of (5) the dissimilarities of the cephalic-index, stature, and hair color, in Italy, basing my calculations on Livi's material.[1] The following tables give the results of this calculation:

TABLE I, CEPHALIC INDEX

| | Dissimilarity | Average cephalic index | Average cephalic index of individuals judged to belong to each series [a] |
|---|---|---|---|
| Piemont | 0.103 | 85.9 | 87.8 |
| Liguria | (−) 0.061 | 82.3 | 82.3 |
| Lombardy | 0.083 | 84.4 | 85.2 |
| Venice | 0.088 | 85.0 | 86.2 |
| Emilia | 0.091 | 85.2 | 86.8 |
| Tuscany | (−) 0.063 | 82.3 | 82.4 |
| Marche | 0.073 | 84.0 | 85.4 |
| Umbria | 0.074 | 84.1 | 85.5 |
| Lazio | (−) 0.067 | 81.0 | 80.0 |
| Abruzzi | (−) 0.065 | 81.9 | 81.7 |
| Campania | (−) 0.068 | 82.1 | 82.0 |
| Puglie | (−) 0.080 | 79.8 | 78.4 |
| Basilicata | (−) 0.072 | 80.8 | 79.9 |
| Calabria | (−) 0.110 | 78.4 | 75.4 |
| Sicily | (−) 0.085 | 79.6 | 78.4 |
| Sardinia | (−) 0.152 | 77.5 | 74.9 |

[a] See p. 438.

TABLE II

| | STATURE | | | HAIR COLOR |
|---|---|---|---|---|
| | Dissimilarity | Average stature | Average stature of individuals judged to belong to each series | Dissimilarity |
| Piemont | 0.0643 | 164.9 | 165.7 | 0.070 |
| Liguria | 0.0672 | 165.5 | 166.8 | 0.069 |
| Lombardy | 0.0667 | 165.3 | 166.6 | 0.066 |
| Venice | 0.0751 | 166.6 | 168.6 | 0.072 |
| Emilia | 0.0673 | 165.3 | 166.8 | 0.066 |
| Tuscany | 0.0682 | 165.6 | 167.1 | 0.070 |
| Marche | (−) 0.0633 | 163.8 | 163.5 | 0.065 |
| Umbria | (−) 0.0636 | 164.2 | 164.4 | 0.064 |
| Lazro | (−) 0.0630 | 164.3 | 164.4 | (−) 0.068 |
| Abruzzi | (−) 0.0654 | 163.2 | 162.3 | 0.068 |
| Campania | (−) 0.0643 | 163.5 | 163.0 | (−) 0.065 |
| Puglie | (−) 0.0646 | 163.5 | 163.0 | (−) 0.064 |
| Basilicata | (−) 0.0689 | 162.6 | 161.3 | (−) 0.068 |
| Calabria | (−) 0.0652 | 163.1 | 162.3 | (−) 0.066 |
| Sicily | (−) 0.0636 | 163.5 | 162.9 | (−) 0.065 |
| Sardinia | (−) 0.0754 | 161.9 | 160.4 | (−) 0.077 |

I have calculated these tables from the summary of observations for sixteen provinces. The minimum of dissimilarity is therefore 0.06275, and it will be seen that a number of provinces differ so little from the mass of the Italian material that they have no distinguishing characteristics. On the other hand, Piemont and Sardinia show, comparatively, very great differences.

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[1] Rodolfo Livi, *Antropometria Militare*, pp. 248–49; 266–67; 286–87.

If a number of independent traits are examined together the probability of a correct assignment increases. When the probability of correct assignments for various traits are $p_1, p_2 \ \ . \ \ . \ \ . \ \ p_r$, then the probability of an incorrect assignment considering all the characteristics together will be

$$(1-p_1)(1-p_2) \quad . \quad . \quad . \quad (1-p_r).$$

When all the series are identical, and only one trait is studied, the probability of an incorrect judgment will be $\frac{n-1}{n}$, where $n$ is the number of series compared. For $r$ independent traits, the probability of an incorrect judgment in identical series will be $\left(\frac{n-1}{n}\right)^r$. This value represents the maximum probability of an incorrect judgment. The minimum probability of an incorrect judgment occurs in cases of absolute difference of all individuals, and is zero.

The values of probabilities derived from a combination of several characteristics may be made more comparable by determining the ratio between $\left(\frac{n-1}{n}\right)^r$ and the observed value of the product $(1-p_1)$ $(1-p_2) \ \ . \ \ . \ \ . \ \ (1-p_r)$.

Applying this to the sixteen provinces of Italy, tabulated on page 435, we find the maximum probability of misjudgment for a single characteristic to be $\left(\frac{15}{16}\right)$, or 0.937; for two characteristics combined, $\left(\frac{15}{16}\right)^2$, or 0.879; for three characteristics combined, $\left(\frac{15}{16}\right)^3$, or 0.824.

Table III gives the absolute probabilities of misjudgments (column I) and their ratio to the maximum probability of a misjudgment based on a single character, namely, 0.937 (column II in the first three double columns). Column II in the fourth double column gives the ratio between the maximum probability of a misjudgment based on a comparison of two characters and the observed probability of a misjudgment for head index and stature. Column II in the last double column gives the same for three characters, namely, head index, stature, and hair color.

In this series Piemont and Sardinia appear as the most distinct areas. It seems then justifiable to compare these alone in order to determine their dissimilarity. According to the same method, applied

TABLE III

| | Cephalic index | | Stature | | Hair color | | Cephalic index and stature | | Cephalic index, stature, and hair | |
|---|---|---|---|---|---|---|---|---|---|---|
| | I | II | I | II | I | II | I | II | I | II |
| Piemont | 0.897 | 0.957 | 0.936 | 0.999 | 0.930 | 0.993 | 0.840 | 0.956 | 0.781 | 0.948 |
| Liguria | 0.939 | 1.000 | 0.933 | 0.996 | 0.931 | 0.994 | 0.876 | 0.997 | 0.816 | 0.990 |
| Lombardy | 0.917 | 0.979 | 0.933 | 0.996 | 0.934 | 0.997 | 0.855 | 0.973 | 0.799 | 0.970 |
| Venice | 0.912 | 0.973 | 0.925 | 0.987 | 0.928 | 0.990 | 0.844 | 0.960 | 0.783 | 0.950 |
| Emilia | 0.909 | 0.970 | 0.933 | 0.996 | 0.934 | 0.997 | 0.848 | 0.965 | 0.792 | 0.961 |
| Tuscany | 0.937 | 1.000 | 0.932 | 0.995 | 0.930 | 0.993 | 0.873 | 0.993 | 0.812 | 0.985 |
| Marche | 0.927 | 0.989 | 0.937 | 1.000 | 0.935 | 0.998 | 0.869 | 0.989 | 0.813 | 0.987 |
| Umbria | 0.926 | 0.988 | 0.936 | 0.999 | 0.936 | 0.999 | 0.867 | 0.986 | 0.811 | 0.984 |
| Lazro | 0.933 | 0.996 | 0.937 | 1.000 | 0.932 | 0.995 | 0.874 | 0.994 | 0.815 | 0.989 |
| Abruzzi | 0.935 | 0.998 | 0.935 | 0.998 | 0.932 | 0.995 | 0.874 | 0.994 | 0.815 | 0.989 |
| Campania | 0.932 | 0.995 | 0.936 | 0.999 | 0.935 | 0.998 | 0.872 | 0.992 | 0.815 | 0.989 |
| Puglie | 0.920 | 0.982 | 0.935 | 0.998 | 0.936 | 0.999 | 0.860 | 0.978 | 0.805 | 0.977 |
| Basilicata | 0.928 | 0.990 | 0.931 | 0.994 | 0.932 | 0.995 | 0.864 | 0.983 | 0.805 | 0.977 |
| Calabria | 0.890 | 0.950 | 0.935 | 0.998 | 0.934 | 0.997 | 0.832 | 0.947 | 0.777 | 0.943 |
| Sicily | 0.915 | 0.977 | 0.936 | 0.999 | 0.935 | 0.998 | 0.856 | 0.974 | 0.800 | 0.971 |
| Sardinia | 0.848 | 0.905 | 0.925 | 0.987 | 0.923 | 0.985 | 0.784 | 0.892 | 0.724 | 0.879 |

to these two territorial divisions alone, we find the dissimilarities as shown in Table IV.

Thus, the probability of a misjudgment for Sardinians and Piemontese for cephalic index alone is 0.420 of the probability for identical series; for cephalic index and stature it is 0.389; and for cephalic index, stature, and hair color it is 0.342 of the probability for identical series. Still more strictly speaking, we may express the last column in the following way: In attempting a classification of individuals belonging to two identical series for which three measurements are compared, $(\frac{1}{2})^3$ out of the total number, or 125 out of 1,000 individuals, will be misplaced, but only 43 out of 1,000 are misplaced when comparing Sardinians and Piemontese.

The method here outlined enables us to segregate the most distinctive groups from the mass of overlapping material that belongs to a large area, as we have segregated here the Piemontese and Sardinians.

TABLE IV

| | Cephalic index | | Cephalic index and stature | | Cephalic index, stature, and hair color | |
|---|---|---|---|---|---|---|
| | I | II | I | II | I | II |
| Cephalic index | 0.210 | 0.420 | .... | .... | .... | .... |
| Stature | 0.463 | 0.926 | 0.097 | 0.389 | 0.043 | 0.342 |
| Hair | 0.438 | 0.976 | .... | .... | .... | .... |

It will be noted that in our example Venice and Calabria are also strongly divergent in type. A study of the measurements of these provinces shows that Calabria may be combined with Sardinia, while Venice appears somewhat distinct from Piemont. Accordingly, Calabria and Sardinia should be united. By a gradual elimination of intermediate forms it is possible not only to segregate the most divergent types of an area but also to determine the degree of their similarity.

In applying the fundamental thought underlying our considerations to the classification of mankind, we might ask ourselves which are the series for which the similarity or the probability of a misjudgment becomes zero, and these might be considered as the present fundamental human types. A satisfactory solution of this problem must not be based on the consideration of a few standardized measurements, but the features to be studied must be selected after a careful investigation of what is most characteristic of each group.

It is also feasible to find in this manner outstanding types of a definite area and to arrange them according to the degrees of their similarity. The interpretation of the similarity, whether due to mixture, environment, or other causes, is of course a purely biological problem for which the statistical inquiry furnishes the material but which cannot be solved by statistical methods.

We have seen that the individuals of a definite bodily form are not all assigned by us to the group to which they belong. The impression which we receive of characteristic forms of a particular series depends upon the distribution and the forms of individuals which we assign to it. While their distribution does not conform to the exponential function, it does not differ fundamentally from the distribution of other variable phenomena, and for this reason our impression of the general characteristic form of the series is expressed by the average of individuals that we assign to it. This value is

$$a=\int_{-\infty}^{+\infty}\frac{Xp_r^2p_r'}{\Sigma p'}dx, \tag{6}$$

or, if the values of $p^1$ are equal,

$$a=\int_{-\infty}^{+\infty}\frac{Xp_r^2}{\Sigma p}dx. \tag{6*}$$

This calculation for Italy has been carried out on the basis of the previous tables. The psychological impression of characteristic head forms of each province of Italy is given in the last column of the table on page 435, while the second columns contain the actual averages.

This table is suggestive because it shows that we receive an exaggerated impression of the characteristics of a series, because individuals that are similar to other series are assigned to them according to their appearance and are merged in the general background represented by the aggregate. Our impression, however, does not correspond to an actual type. This proves that the attempts to analyze a series according to similarities of individuals into a number of subtypes is methodologically not admissible, and that all subdivisions must be based on the study of the series as a whole, not upon selected types.

The chief difficulty in the practical application of the method outlined in the preceding pages is due to the facts that the degree of similarity depends upon the aggregate treated, and that there is no relation between the numerical values obtained for different aggregates. Not even the equality of differences between several given series need persist if new members are added to the aggregate or are taken away from it.

In cases of continuous changes of a type from one extreme form to another, an artificial classification of the aggregate is unavoidable. By means of repeated adjustment equal degrees of similarity might be found according to the method outlined here, but the actual carrying out of such a plan offers serious difficulties. In such cases each series might be considered as a specialized form of the general aggregate and compared with it. The aggregate itself may, however, be established in two different ways. We may disregard the number of existing individuals, considering each morphological type contained in the aggregate as a unit. The units would then be given equal weight (*i. e.*, equal numbers of cases). Or we may take the whole series as it exists at the present time, counting the total number of individuals that it contains, regardless of local types that may represent the same morphological form. By either of these methods we ascertain how dissimilar each morphological type is from the aggregate, but these values cannot be used to determine the mutual dissimilarities of the single series contained in the aggregate. When the types are combined according to the present actual number of individuals representing them, the most numerous type will appear least distinct from the average, merely on account of the large number of its members. This difficulty can hardly be avoided by comparing each series with the aggregate of the remaining series, because by this method the standard of comparison is always changing. On the other hand, the formation of the aggregate by giving equal weight to each morphological type entails the difficulty that we tried to avoid, namely, an arbitrary classification of the groups as a number of morphological types.

The problem may be approached in another manner. We may determine the frequency distribution of the differences between individuals belonging to one series and those belonging to all the other series of the aggregate. In this inquiry we have to determine the average difference between the representatives of one series and those of all the other series, and the variability of this difference. When the series are arranged in pairs, the differences between the averages are additive, but the variabilities are not comparable. The difference between a series (1) and a series (2) will have the variability $\pm\sqrt{\sigma_1^2+\sigma_2^2}$, so that if one series is taken as the basis of comparison with all the others, the variabilities have a significance only in relation to the one series which has been arbitrarily selected as a standard.

The interrelations between the series can be determined only when we consider any one series in relation to all the others. Assuming again that all the series are known, we may call the values of the particular series

$$\begin{array}{c} a_1+x_1 \\ a_2+x_2 \\ \cdot \quad \cdot \\ \cdot \quad \cdot \\ \cdot \quad \cdot \\ a_n+x_n. \end{array}$$

The differences between one series and all the others taken successively will be

$$\begin{array}{c} (a_1-a_2)+(x_1-x_2) \\ (a_1-a_3)+(x_1-x_3) \\ \cdot \qquad \cdot \\ \cdot \qquad \cdot \\ (a_1-a_n)+(x_1-x_n), \end{array}$$

or since there are $n-1$ groups of this type, the average difference will be

$$\frac{n}{n-1}a_1-\frac{\Sigma a}{n-1}.$$

The mean square variability of this difference will be

$$\frac{1}{n-1}\left\{(x_1-x_2)^2+(x_1-x_3)^2+\quad . \quad . \quad . \quad +(x_1-x_n)^2\right\},$$

or

$$\frac{n-2}{n-1}\sigma_1^2+\frac{\Sigma\sigma^2}{n-1}.$$

We have, therefore, the characteristic difference between series (1) and the rest of the series

$$\frac{n}{n-1}a_1-\frac{\Sigma a}{n-1} \quad \sqrt{\frac{n-2}{n-1}\sigma_1^2+\frac{\Sigma\sigma^2}{n-1}}.$$

If we assume a distribution according to the probability function, the differences may be made comparable by measuring them by their standard deviations. The difference between series (1) and all the other series taken conjointly will therefore be

$$(7)\qquad \frac{na_1-\Sigma a}{\sqrt{(n-1)(\overline{n-2}\,\sigma_1^2+\Sigma\sigma^2)}},$$

or

$$\frac{n}{n-1}\,\frac{a_1-[a]}{\sqrt{[\sigma^2]+\sigma_1^2+\dfrac{[\sigma^2]-\sigma_1^2}{n-1}}}.$$

If $n$ is sufficiently large, we may write approximately

$$(8)\qquad \frac{a_1-[a]}{\sqrt{[\sigma^2]+\sigma_1^2}},$$

which is the difference between the average of series (1) and the average of the total aggregate including series (1) measured by its variability. From this value and by means of a table of the probability integral may be determined the probability that the difference between an individual belonging to series (1) and any other individuals of the aggregate has any selected value, particularly the probability that this difference may be greater or less than zero.

The advantages of this definition of difference is the relative stability of the values obtained when the series are arranged in different groups. As an instance I give the calculation for Italy. Table V gives the averages and variabilities of the cephalic index for each circondario. In each column are given the number of occurrences of the values of the average cephalic index by half units, as 76.0–76.4, 76.5–76.9, etc.

TABLE V

| Variability | Cephalic index | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 76 | | 77 | | 78 | | 79 | | 80 | | 81 | | 82 | | 83 | | 84 | | 85 | | 86 | | 87 | |
| 3.00–3.24 | . | . | . | . | . | . | . | . | . | 1 | . | . | . | . | . | . | 3 | 1 | . | . | . | . | . | . |
| 3.25–3.49 | . | 1 | . | . | 1 | 2 | 4 | 1 | 2 | 1 | . | 1 | . | 4 | 2 | 1 | 3 | 3 | 5 | 2 | 1 | 1 | . | . |
| 3.50–3.74 | . | . | 2 | 4 | 6 | 1 | 2 | 6 | 6 | 4 | 2 | 6 | 3 | 4 | 4 | 1 | 6 | 4 | 6 | 3 | 4 | 2 | . | 2 |
| 3.75–3.99 | | . | 2 | 1 | 1 | 2 | 1 | 3 | . | 3 | 6 | 4 | 1 | 2 | 5 | 3 | 1 | 3 | 6 | 3 | 3 | 4 | . | . |
| 4.00–4.24 | . | . | . | 1 | 1 | 1 | 2 | 1 | 2 | 1 | . | 3 | 1 | 2 | 2 | 1 | 2 | 1 | 1 | 1 | . | 2 | . | . |
| 4.25–4.49 | . | . | . | . | . | . | . | . | . | . | . | 2 | . | . | 1 | 1 | 2 | 1 | . | 1 | . | . | . | . |
| 4.50–4.74 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 1 | . | . | . | . | . | . | . | . |

Considering each combination of an index and a variability occurring in Table V as a single morphological group, we obtain the values given in Table VI for formula (8) for 84 such groups. Considering

### TABLE VI

| Variability | Cephalic index | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 |
| 3.00-3.24... | .... .... | .... .... | .... .... | .... .... | .... −.33 | .... .... | .... .... | .... .... | +.38 +.49 | .... .... | .... .... | .... .... |
| 3.25-3.49... | −1.21 .... | .... .... | −.82 −.72 | −.62 −.52 | −.42 −.32 | .... −.12 | −.02 .... | +.18 +.28 | +.37 +.47 | +.57 +.67 | +.77 +.87 | .... .... |
| 3.50-3.74... | .... .... | −.98 −.88 | −.79 −.69 | −.60 −.50 | −.40 .... | −.21 −.12 | −.02 +.07 | +.17 +.27 | +.36 +.46 | +.55 +.65 | +.74 +.84 | .... +1.03 |
| 3.75-3.99... | .... .... | −.94 −.85 | −.76 −.67 | −.57 −.48 | −.39 .... | −.20 −.11 | −.02 +.07 | +.16 +.26 | +.35 +.44 | +.53 +.62 | +.72 +.81 | .... .... |
| 4.00-4.24... | .... .... | .... −.82 | −.73 −.64 | −.56 −.47 | −.38 −.29 | .... −.11 | −.02 +.07 | +.16 +.25 | +.34 +.43 | +.52 +.61 | +.69 .... | .... .... |
| 4.25-4.49... | .... .... | .... .... | .... .... | .... .... | .... .... | .... −.11 | .... .... | +.15 +.24 | +.33 +.41 | +.50 +.59 | .... .... | .... .... |
| 4.50-4.74... | .... .... | .... .... | .... .... | .... .... | .... .... | .... .... | .... .... | .... +.23 | .... .... | .... .... | .... .... | .... .... |

### TABLE VII

| Variability | Cephalic index | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 |
| 3.00-3.24... | .... .... | .... .... | .... .... | .... .... | .... −.36 | .... .... | .... .... | .... .... | +.36 +.46 | .... .... | .... .... | .... .... |
| 3.25-3.49... | −1.24 .... | .... .... | −.84 −.74 | −.65 −.55 | −.45 −.35 | .... −.15 | −.05 .... | +.15 +.25 | +.35 +.45 | +.55 +.65 | +.75 +.84 | .... .... |
| 3.50-3.74... | .... .... | −1.01 −.91 | −.82 −.72 | −.63 −.53 | −.43 −.34 | −.24 −.14 | −.05 +.05 | +.14 +.24 | +.34 +.43 | +.53 +.63 | +.72 +.82 | .... +1.01 |
| 3.75-3.99... | .... .... | − .98 −.88 | −.79 −.70 | −.60 −.51 | −.42 .... | −.23 −.14 | −.05 +.05 | +.14 +.23 | +.32 +.42 | +.51 +.60 | +.70 +.79 | .... .... |
| 4.00-4.24... | .... .... | .... −.85 | −.76 −.67 | −.58 −.49 | −.40 −.31 | .... .13 | .04 +.04 | +.13 +.22 | +.31 +.40 | +.49 +.58 | +.67 .... | .... .... |
| 4.25-4.49... | .... .... | .... .... | .... .... | .... .... | .... .... | .... .13 | .... .... | +.13 +.22 | +.30 +.39 | +.48 +.57 | .... .... | .... .... |
| 4.50-4.74... | .... .... | .... .... | .... .... | .... .... | .... .... | .... .... | .... .... | .... +.21 | .... .... | .... .... | .... .... | .... .... |

## TABLE VIII

| Variability | Cephalic index | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 |
| 3.00–3.49 .... | −1.14 | .... | −.74 | −.54 | −.34 | −.14 | +.06 | +.26 | +.46 | +.66 | +.86 | .... |
| 3.50–3.99 .... | .... | −.88 | −.69 | −.51 | −.32 | −.13 | +.06 | +.24 | +.43 | +.62 | +.81 | +.99 |
| 4.00–4.49 .... | .... | −.83 | −.65 | −.48 | − 30 | −.12 | +.05 | + 23 | +.40 | +.58 | +.76 | .... |
| 4.50–4.99 .... | .... | .... | .... | .... | .... | .... | .... | +.21 | .... | .... | .... | .... |

## TABLE IX

| Variability | Cephalic index | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 |
| 3.00–3.49 .... | −1.21 | .... | −.81 | −.60 | −.40 | − 20 | ±0.00 | +.20 | +.40 | +.60 | +.81 | .... |
| 3.50–3.99 .... | .... | −.94 | −.75 | +.57 | −.38 | −.19 | ± .00 | +.19 | +.38 | +.57 | +.75 | +.94 |
| 4.00–4.49 .... | .... | −.88 | −.71 | −.53 | −.35 | −.18 | ± .00 | +.18 | +.35 | +.53 | +.71 | .... |
| 4.50–4.99 .... | .... | .... | .... | .... | .... | .... | .... | +.17 | .... | .... | .... | .... |

the population in its actual distribution, *i. e.*, counting each morphological group according to the actual number of its occurrence, we get for 206 groups the figures given in Table VII. For whole units of cephalic index and half units of variability the corresponding figures for 32 morphological units are given in Table VIII; and counting the actual frequencies of the single groups we obtain the figures given in Table IX.

The problems take a slightly different form when populations are compared with regard to features that occur in a certain percentage of individuals and are absent in the rest. If, for instance, one population consists of 15 per cent negroes and 85 per cent whites, another one of 30 per cent negroes and 70 per cent whites, it might seem that the difference could be stated simply as a difference of 15 per cent, but obviously the dissimilarity of these two types of population would not be the same as in another pair in which we have 40 per cent negroes and 60 per cent whites in one and 55 per cent negroes and 45 per cent whites in the other. In the latter case the populations would seem more alike to us than in the former case. This difficulty is still more pronounced if there are present not merely two types but a larger number of types in varying proportions. In all these cases we may apply the same methods which we used for the determination of similarity of measurable quantities.

The first method of determining similarities may be applied to this problem without change. If a certain feature has the probabilities $p_1, p_2, p_3 \quad . \quad . \quad . \quad p_n$ in a number of series, then the frequency of its occurrence in any one of the $n$ series will be $p_1+p_2+p_3+ \quad . \quad . \quad . \quad +p_n$. The probability that a single individual of series $r$ whose provenience is not known is assigned correctly will be, therefore, $\frac{p_r}{\Sigma p}$, and if the probability of occurrence of an individual of this series is $pp'$, then the total probability of a correct assignment will be $\frac{p_r^2 p_r'}{\Sigma pp'}$, or if we disregard the number of cases in each series, $\frac{p_r^2}{\Sigma p}$. The sum of these values for all the distinct traits occurring in the population, that is, $\Sigma\frac{p_r^2 p_r'}{\Sigma p'p}$, will be the total probability of a correct assignment. In a case in which only two forms constitute a population, and comparing two populations only, we have accordingly for equal numbers of $p'$

$$\frac{p_1^2}{p_1+p_2}+\frac{(1-p_1)^2}{1-p_1+1-p_2}.$$

According to the second method we have to determine the average difference between individuals of the several series and its variability. If in a series the probability of the occurrence of a phenomenon is $p$, then those individuals in which it does occur, and who therefore have the probability of occurrence 1, have a deviation from the probability of the series $1-p$; those in whom it does not occur and who therefore have the probability of occurrence 0, have a deviation from the probability of the series $-p$. Of the former there are $p$ cases, of the latter $1-p$ cases. We have, therefore, the following combinations:

| The phenomenon is | Frequency | | |
|---|---|---|---|
| present in series (1), present in (2) | $p_1p_2$ | times | 0 |
| present in series (1), absent in (2) | $p_1(1-p_2)$ | " | $+1$ |
| absent in series (1), present in (2) | $(1-p_1)p_2$ | " | $-1$ |
| absent in series (1), absent in (2) | $(1-p_1)(1-p_2)$ | " | 0 |

The last column represents the average differences between the probabilities of occurrence for each combination.

The average is therefore

$$p_1(1-p_2)-p_2(1-p_1)=p_1-p_2.$$

We have, therefore, the following deviations from the averages and their squares:

| Frequencies | | Difference of each series from average $(p_1-p_2)$ | Squares of differences |
|---|---|---|---|
| $p_1p_2$ | times | $-(p_1-p_2)$ | $(p_1-p_2)^2$ |
| $(1-p_1)(1-p_2)$ | " | $-(p_1-p_2)$ | $(p_1-p_2)^2$ |
| $p_1(1-p_2)$ | " | $1-(p_1-p_2)$ | $(1-\overline{p_1-p_2})^2$ |
| $p_2(1-p_1)$ | " | $-1-(p_1-p_2)$ | $(1+\overline{p_1-p_2})^2$ |

and by addition

$$\sigma^2=p_1(1-p_1)+p_2(1-p_2).$$

When we compare in this manner $p_1$ with all the other series, we obtain as before

$$\begin{aligned} a &= \frac{n}{n-1}p_1-\frac{\Sigma p}{n-1} \\ &= \frac{n}{n-1}(p_1 1-[p]) \\ \sigma &= \pm\sqrt{\frac{n-2}{n-1}p_1(1-p_1)+\frac{\Sigma p(1-p)}{n-1}} \\ &= \pm\sqrt{p_1(1-p_1)+[p(1-p)]+\frac{[p(1-p)]-p_1(1-p_1)}{n-1}}. \end{aligned}$$

Since $\sqrt{p(1-p)}$ is the standard deviation for $p$, the formula appears identical with the one previously derived.

# THE LONG-TIME CYCLES OF PANDEMIC INFLUENZA[1]

By Otto R. Eichel, *New York State Department of Health*

The object of this paper is to present briefly some observations on the occurrence, in point of time, of the great influenza pandemics, and to indicate certain phases, the statistical study of which may prove valuable. For this purpose the term "pandemic" is applied to those great epidemics which have not only affected a whole country, continent, or hemisphere, but have, in a series of great waves, encircled the entire globe. The term "influenza" is here used to designate the disease or clinical entity usually known by that name to physicians; it refers also to the same disease known by other names before the term influenza came into general use.

The study of these phenomena in the light of history is of course limited in precision by the absence of mortality statistics in modern form previous to about the last century and a half. Nevertheless, the pandemics stand out so clearly in the history of the last four centuries that one may endeavor to measure them roughly and to interpret their relationship to each other. Viewed in this perspective they present a picture characterized by unmistakable features.

Our sources of data are chiefly the descriptive and critical studies of Hirsch, Creighton, Leichtenstern, Thompson, and others, and official vital statistics. Previous to the seventeenth century the records were made for the most part by lay chroniclers; subsequent to the days of the great Sydenham, in the early seventeenth century, physicians in increasing numbers recorded their findings; and during the nineteenth century there accumulated an extensive literature including descriptive official statistics. It must be noted that before the last century the scientific writers on influenza, chiefly physicians, compensated for their lack of the precise methods and resources of modern clinics, laboratories, and official records, not only by comprehensive and minute observations, but also by a thorough mastery of language in presenting them.

The method used to identify and relate to each other the historic influenza epidemics cannot be stated in exact detail in this brief paper, but it will be described sufficiently to make clear the procedure. We selected the records of England and Wales as a measure of the pandemicity of influenza because they cover a long period of time and are readily available, including critical studies of them, especially by Creighton.

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[1] Read at the Eighty-third Annual Meeting of the American Statistical Association at Pittsburgh, Pa., December, 1921.

The first step is to chart the annual influenza death rates of England and Wales since 1838 from data in the yearly reports of the Registrar-General, with the exception of a negligible interval of four years during which no epidemic occurred and for which figures are not available. The English "bills of mortality" were printed first in 1629, although the parish registers of deaths had been kept since 1538 and various parish bills of mortality were compiled as early as 1532. Next, from Creighton's study of the records and other sources of information, we are able roughly to estimate the mortality [1] of these various epidemics from 1510 to 1838: (1) of definite influenza; (2) of indefinite but very probable influenza; (3) of mild and doubtful character which may possibly have been influenza. These three classes must be held clearly in mind in our subsequent discussion. (See Charts I and II.)

In this connection, the nomenclature of influenza is important because throughout its history it appears under a great variety of names, many of them popular designations indicating either the severity or the mildness of the disease. In 1782 the term "influenza" was formally adopted by the College of Physicians in England and since then has been in general use in the English literature. But the wealth of medical and lay descriptions of the epidemics previous to 1782 establishes clearly the clinical character of the important influenza outbreaks.

For charting and comparison the epidemics may then be classified as follows, with regard to their relative severity and probable annual mortality from influenza per 100,000 population for the entire year in which each epidemic occurred:

1. Very mild; rate under 15.
2. Mild; rate over 15 and under 30.
3. Moderately severe; rate over 30 and under 45.
4. Very severe; rate 45 or over.

Although the definitions involve assumptions, derived from study of the annual statistics of the Registrars-General since 1838, in order to designate the relative severity of each epidemic preceding that year, it is not a matter of moment for our purpose whether such designations do accurately represent the real mortality. These groups might be reduced to 2 or 3, or extended to 6, and the corresponding mortality values likewise raised or lowered, and it would still be possible readily to allocate to them any of the historic epidemics with regard to their severity *as compared with each other* and with those which followed

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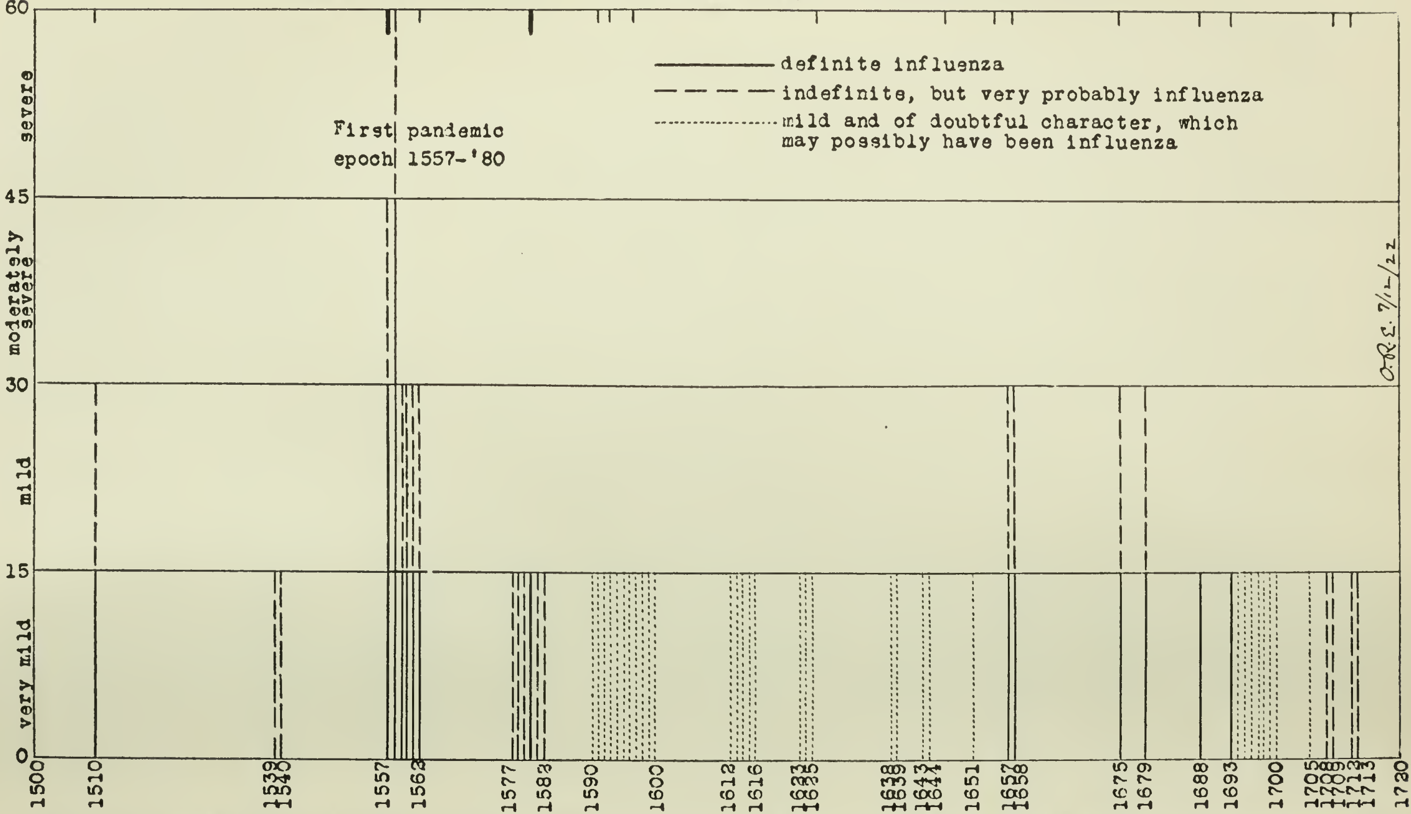
[1] The term "mortality" is used in this paper to indicate deaths in proportion to population.

## Chart I

## THE LONG TIME CYCLES OF INFLUENZA IN ENGLAND AND WALES

Annual death rates per 100,000 population
estimated 1510-1837; from reports of Registrars-General 1838-1921

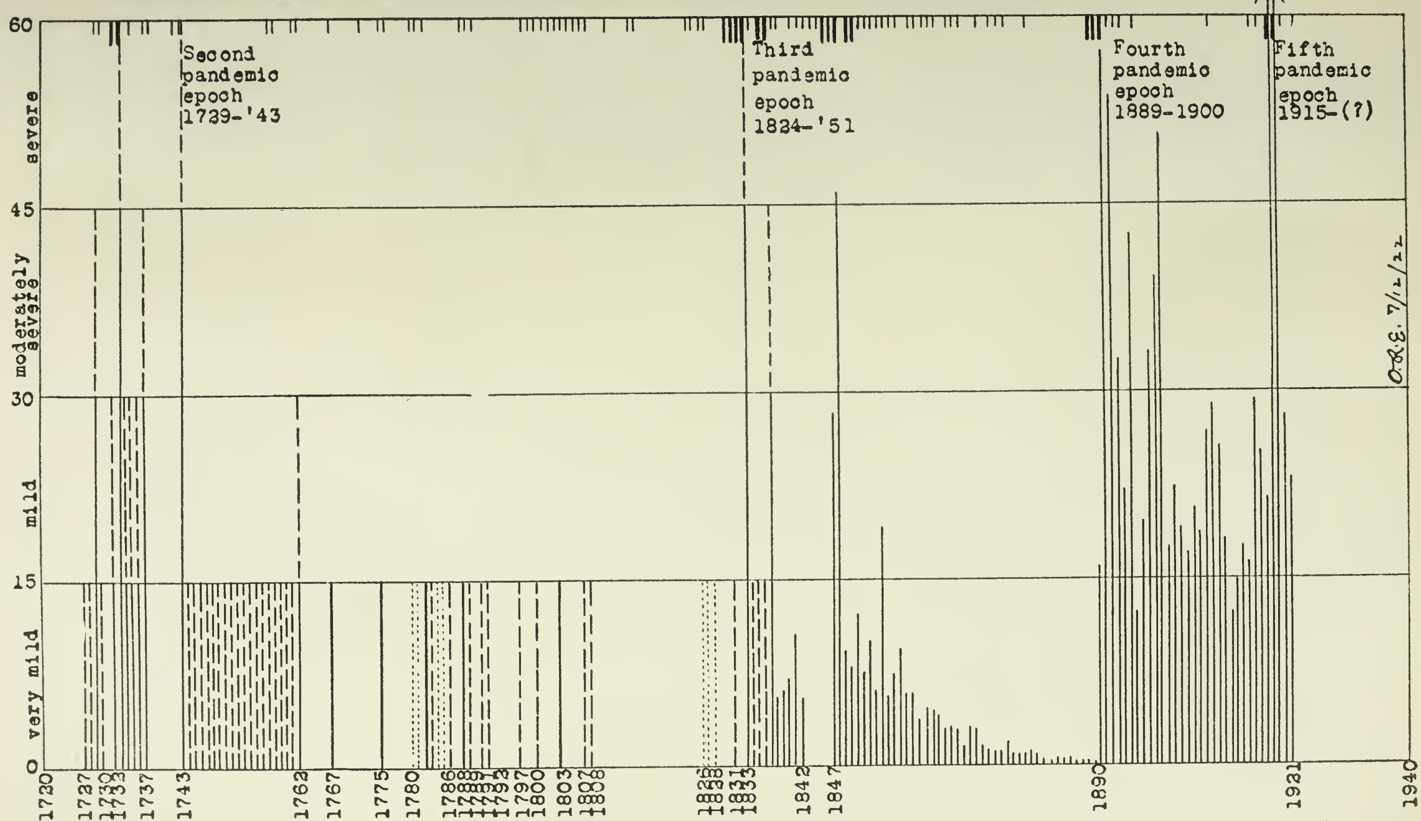


O.R.E. 7/12/22

N.B. Short bars at top of graph show years of influenza epidemics in other countries; heavy bars show years of world-wide outbreaks, or real pandemics. ( Also see foot note to Chart II.)

Chart II

THE LONG TIME CYCLES OF INFLUENZA IN ENGLAND AND WALES ( Concluded from Chart I )



O.R.E. 7/12/22

N.B. The broken parts of the continuous bars show the range within which the actual mortality probably fell, in both Charts I and II. ( Also see foot note to Chart I.)

The actual rate for 1918 is over five times as high as that shown on the chart, and the rate for 1919 is nearly twice that represented.

1838. Even if opinion should differ as to whether a certain epidemic was mild or moderately severe, or otherwise, or whether or not it was true influenza, it would be found that it could be allocated approximately, according to the definitions formulated, both as to severity and to the certainty of its being true influenza. Allowing for wide differences of judgment, the resulting graphic pictures in each instance would still present the same significant features.

The data thus prepared are then plotted in their proper places on the chart constructed to show the annual influenza death rates since 1838 and according to the same scale.

Inasmuch as very extensive outbreaks [1] occurred which left little or no impress on the bills of mortality or the later official statistics, these questions now arise: (1) For the present purpose, is the mortality a reliable index of epidemicity? (2) Are great epidemics causing heavy mortality *in Britain* a reliable index to the pandemics?

The answers to these questions are evident from the fact that the years of severe outbreaks with high influenza mortality in Britain coincide with those periods during which the disease was encircling the globe and causing high mortality everywhere. Such pandemic periods or "epochs" (a term suggested by Leichtenstern) were followed by *occasional* less fatal outbreaks in the long interval of time before the next pandemic epoch began, some of which were very extensive, indicating a high degree of communicability, and affected large proportions of the people of a country, or even a continent or hemisphere.[2] Not only was the mortality low but the fatality (*i. e.*, percentage of fatal cases) also must have been low—a condition characteristic of the terminal phase of severe epidemics of various diseases. These mild and extensive epidemics did not coincide with periods of truly worldwide diffusion, but they are very confusing in the chronological history of the disease and seem to have obscured the picture of the real pandemic waves and their rise and subsidence. These waves form a remarkable and consistent sequence of events when viewed quantitatively.

In 1510 there occurred in Europe (then, of course, the chiefly known portion of the world) a wave of influenza which many students regard as the first real outbreak which ever occurred. In the chronicles of earlier epidemics there is evidence of influenza outbreaks, but this is much confused because of the frequent recurrence of pestilences during the Middle Ages. Creighton quotes Short's statement that in 1510 "none died except some children"; Short failed to state his authority, but Creighton surmised it was probably the continental chroniclers. Therefore, as the mortality was doubtless low, we may suspect that the 1510 wave was only an incident in the decline of some great previous pandemic, perhaps that of 1173 (regarded by Hirsch as the first authentic epidemic) which was recorded in Britain, Italy, and Germany and doubtless appeared elsewhere on the Continent. The reason for suspecting this sequence would be its apparent consistency with the course of events in the subsequent history of the disease.

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[1] The word "outbreak" is used synonymously with "epidemic" in this paper.

[2] For example, the outbreaks of 1767, 1781, 1802–3, and 1874–75.

*For practical purposes a pandemic epoch may be defined as beginning with that year in which those first authentic outbreaks occurred anywhere in the world which developed into waves of pandemic proportions, after a series of years in which apparently no epidemic occurred anywhere; the end of the epoch may be dated as either the last year of high* (*or severe*) *influenza mortality in Great Britain or of world-wide, or nearly world-wide, epidemic diffusion of the disease before a general decline of the mortality begins.*

After the opening of the sixteenth century the first giant wave of influenza arose in 1557, rapidly spreading over the then known world. This outbreak persisted in Britain during 1558, taking a heavy toll of lives, and was followed by revivals up to the year 1580 both in Britain and on the Continent. This may be regarded as the first definitely known pandemic epoch. It covered a period of 24 years.

The second epoch began in 1729 and persisted to 1743, a period of 15 years, in the midst of which there occurred in Britain, in 1733 and in 1743, two very severe epidemics, which were believed by Creighton to be the most severe in the history of Britain previous to the time of his writing (1894). During this epoch, in various years, there occurred similar severe outbreaks in other countries, including North America. One writer stated that 80,000 persons were sick in Rome in 1743, and that 500 were buried in one day.

The third epoch began about 1824 and persisted to 1851, a term of 28 years, during which there occurred in different years and in various countries of the entire world very severe epidemics resulting in heavy mortality from the disease.

The fourth epoch may be regarded as that of 1889 to 1900, a term of 12 years, the details of which are recent knowledge.

The fifth epoch began in 1915 [1] and *is still in progress.* The first pandemic invasion was the great wave of 1918, which has been followed by several revivals in various countries, some of serious proportions as to mortality. This, doubtless, was the most fatal of all influenza pandemics and was perhaps the greatest single catastrophe of modern times, not excepting wars.

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[1] Influenza appeared widely in epidemic form in the United States in December, 1915, and January, 1916, being reported definitely from 22 states. See U. S. Public Health Reports for January 7, 1916.

Therefore the duration of the first four epochs being roughly 24, 15, 28, and 12 years respectively, or an average of 19.8 years, it is clear that the epoch beginning in 1915 will very probably contain one or more severe epidemics, or pandemic waves, in addition to that of 1918. These outbreaks should be anticipated during the 10 to 20 years following 1915.

A curious fact in connection with each of these great epochs is that upon the occurrence of the first severe epidemic phase, both the laity and the medical world immediately questioned the identity of the infection with that of other previous outbreaks. In former times these epidemics were frequently referred to in Britain as epidemics of a "new disease," "strange disease," etc., and, indeed, even during the present pandemic period able observers have questioned whether the disease is the same as that of other years, or in one recent epidemic as compared with another. Regardless of clinical and pathological differences observed in the study of individual patients, a quantitative review of the mass of mortality data may be of value. Each of the five pandemic epochs just described was immediately followed by a series of years during which the mortality from the disease remained generally high. This mortality for each year is definitely known in England and Wales since 1838. In the outbreak of 1847 the influenza death rate per million was 285, in 1848 it was 460; and it remained above 75 for the next five years. In 1851 a recrudescence of the disease raised the rate to 193; the next year it was 55, after which it *declined continuously,* with minor variations, for many years until the decade 1880–89, when it was below 10. During the second half of that decade it fell to only *2 per million!* Then another pandemic invasion caused rates in 1890 and 1891 of 157 and 572 respectively. If depicted graphically (Chart II), this decline during the 40 years from 1850 to 1889 (or beginning approximately with the end of a pandemic epoch) makes a hyperbolic curve if smoothed. This seems to represent a natural phenomenon uninfluenced by human factors and obeying a law susceptible of mathematical expression.

During the interpandemic period from 1889 to 1918 the annual influenza mortality of England as a whole remained on a very much higher level than during the 40 years preceding 1889, and although characterized by extreme fluctuations it nevertheless presents a picture of general decline from 1890 to 1918. Perhaps the most striking and the most interesting feature of the estimated mortality of the epochs previous to 1838 is that each of them contains various minor epidemics with moderately high mortality, in addition to very severe pandemic waves; and each such epoch is immediately followed, for a series of years, by a concentration of moderately high influenza mortality. After the severe outbreak of 1743 in Britain (which marked the end of a pandemic epoch) there occurred during the 19 succeeding years many minor epidemics of influenza and colds, with a well-marked effect on the general mortality, which corresponds to a similar condition observable in the official statistics after the epochs of 1824–51 and 1889–1900. Minor or secondary epidemics after the pandemic wave of 1918–19 were noted during 1919–22 in several countries.

After these periods of high mortality, which followed the great epochs, there still occurred in isolated years in Britain mild epidemics, occasionally very widespread, some of which are doubtful as to identity and some unmistakably real influenza. These, however, left but slight impress upon the bills of mortality and the later official statistics. Thus, as a whole, these periods fit into the picture as do the declining annual death rates in the Registrar-General's statistics during the 40 years before 1890. During the years from 1762 to 1809, when the very mild and unimportant outbreaks were disappearing, it will be noted that these *become less frequent* as the distance becomes greater from the pandemic epoch; so that in 1807–8 slight epidemics of "catarrhal" diseases prevailed in Britain, the character of which was doubtful and the identity with influenza disputed. *These mild outbreaks were followed by a term of 17 successive years during which there occurred no epidemic of any disease resembling influenza.* Then during the 6 years from 1826 to 1832, mild epidemics of a "catarrhal" type of sickness again appeared, and in 1833 there was a very serious influenza epidemic. These slight "catarrhal" outbreaks may be regarded as preliminary to the oncoming storm and as being related directly to the wide diffusion of mild influenza outbreaks in the United States in 1824–25, and in all the Western Hemisphere, Russia, and Siberia in 1826–27, which preceded the universal appearance of the disease in the giant waves of another pandemic epoch. A similar phenomenon preceded 1918, in the constantly increasing pneumonia mortality during several preceding years. One may well consider whether such apparently unimportant but constantly increasing respiratory mortality is not essentially the beginning phase of the pandemic and susceptible of statistical definition.

When the similar events of the great epoch of 1729–43, and its slow disappearance over many years to 1824, are charted, the picture presents features unmistakably like those in the origin of the next pandemic epoch, beginning in 1824, and its subsequent decline down to

1889. It would require but little imagination to construct curves which would represent roughly the long interpandemic declines.

From the foregoing it may be clear why the mild outbreak of 1510 (mentioned early in this paper) may be viewed as an isolated incident in a long curve of decline from a previous great wave. Analagous declines of the mortality from other epidemic infections over long periods of years will be recalled, *e. g.*, plague and leprosy.

One of the many other interesting observations which might be made as to the great influenza epochs is the *apparent* shortening of the time intervals between them during the last four centuries. This relative shortening will be found to exist, regardless of the exact years used to measure the pandemic epochs. These intervals, *or long-time cycles*, may be defined as follows, from the beginning of one epoch to that of the next:

| | | | | |
|---|---|---|---|---|
| From the epoch of | 1557–80 | to that of | 1729–43 | 172 years |
| " " " " | 1729–43 | " " " | 1824–51 | 95 " |
| " " " " | 1824–51 | " " " | 1889–1900 | 65 " |
| " " " " | 1889–1900 | " " " | 1915–(?) | 26 " |

We may supplement this interpretation of the statistical evidence of influenza with these judgments:

1. Pandemic influenza is identical with the influenza of the interpandemic periods: it is an intensely virulent and highly communicable form of the same disease. The disease may differ in clinical or pathological manifestations in various outbreaks.

2. Influenza exists constantly in mild or severe form in one or more countries of the world, or subdivisions of them; and factors, at present unknown, occasionally operate to increase the virulence and communicability of the disease, thus causing either epidemics or pandemics. (This condition becomes apparent when the influenza mortality of Britain is studied in comparison with the historic epidemics.)

3. There is increasing severity and frequency of local outbreaks in one or more countries for several years preceding the first invasion of a pandemic epoch; these preliminary outbreaks seem to begin after a series of years entirely free from epidemics, and may be susceptible of sanitary recognition, if not statistical demonstration.

4. The appearance of influenza in pandemic form is evidence of the presence of a pandemic epoch, during which period of years one or more other severe epidemics or pandemics will occur at intervals of a few months to a few years.

5. The rise and fall of the pandemic epochs, in long-time cycles, indicates that the fundamental causative factors probably have been uninfluenced by preventive measures.

# THE NET VOLUME OF SAVING IN THE UNITED STATES

## MEASURED BY THE INCREASE IN THE TOTAL WEALTH OF THE COUNTRY

By Willford I. King, *National Bureau of Economic Research*

## Part II

### F. AN INDEX OF THE VOLUME OF NET SAVINGS IN THE CONTINENTAL UNITED STATES

The purpose of this section is not to measure the absolute volume of savings in the country, but merely to obtain an index representing the relative changes from year to year in the total volume of the savings of the American people. This index is made up of three components, namely, business savings, personal savings, and governmental savings. Although these three categories are in many respects separate, they are frequently inversely correlated, for the credits in one class often represent debits in another. Thus personal savings and business savings may be invested in government bonds issued to obtain money for current expenses. In this case, although individuals and business firms are increasing their wealth, the government is evidently increasing its debt by an equal amount without accumulating any offsetting assets, and no net social saving has resulted. An index of total savings ought, therefore, to be made up of items representing respectively the three categories mentioned.

The estimate here presented of the savings made by the various business enterprises of the United States is based primarily upon the study recorded in Volume II, Section 24e, of *Income in the United States;*[1] but the totals are different because the estimates of agricultural savings have been revised. Of course, also, the amounts saved each year from the personal incomes of the inhabitants are very large. Since these latter amounts are not recorded directly they can only be estimated from the volume of investments recorded in certain fields.

Business enterprises which have adequate accounting systems, in calculating their surpluses for the year, always make an allowance for depreciation. If we are to compute the aggregate net saving made from personal income, it is similarly necessary to deduct from gross savings amounts which have been lost, wasted, or consumed during the period. As a matter of fact, the data available are not sufficiently complete to enable us to measure the volume either of gross or of net personal savings. It is believed, however, that by combining the annual increases in the respective volumes of certain types of assets an index is obtained which shows with a moderate degree of accuracy the relative amounts of net savings from personal income occurring in different years. The items combined to form this index are:

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[1] By the National Bureau of Economic Research.

1. The increase in savings banks deposits in the United States.
2. The value of new buildings constructed in the United States, less the loss to existing buildings arising through fire and depreciation.
3. Total increases in the net assets of all insurance companies.
4. The face value of new issues of bonds listed on the New York Stock Exchange.
5. The value of the net increase in the number of passenger automobiles owned in the United States.
6. The net increase in holdings by American individuals or firms of foreign securities or other property.

All of these items seem to represent not only gains in individual wealth but, in most instances, growth in social wealth as well. As savings banks gain in deposits they normally add to their investments in productive enterprises. If new building is more than sufficient to offset the deterioration of existing buildings, there is evidently a net increase in the national wealth. Larger assets of insurance companies mean, as a rule, larger loans to entrepreneurs for the purpose of expanding industrial equipment. The proceeds of new[1] bonds listed on the New York Stock Exchange are utilized for like purposes.

While Orientals put their personal savings largely into gold or jewels, Americans build better houses, lay out more beautiful grounds, buy more elaborate furniture, and purchase more expensive automobiles. We have no record of the value of furniture amassed, but we have at least an inkling of the volume of that saving which takes the form of new pleasure cars. An estimate of this quantity has therefore been entered in the record.

In addition to noting variations in the value of private wealth located in the United States it is necessary to consider changes that have occurred in the debits and credits of people abroad in their business dealings with our inhabitants. Before 1914 the people of the United States usually increased their debt to Europe each year. Since that date the reverse has tended to be true. The present worth of claims against Europe is of course a matter of much uncertainty. In constructing this index the simple course has been followed of counting them at their face value.

The inclusion of all of the above items in an estimate of personal saving in the United States seems logical. Although it is evident that they are not entirely independent but overlap in many instances, there seems, nevertheless, no reason for believing that their sum may not be used to advantage as an index for measuring the changes from year to year in the volume of net personal saving. At first thought it appears that the accuracy of this index might be improved by increasing the number of items upon which it is based. Careful consideration, however, has shown that some ostensibly satisfactory criteria in reality either are not measurable or fail to meet our needs. Examples of items which have been rejected on such grounds are (1) new stocks listed on the New York Exchange, excluded because stocks are sold only rarely at par for cash, and in many instances have no par value, and (2) gains in demand deposits in banks, excluded because they generally represent business borrowing rather than personal savings.

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[1] Bonds not issued for refunding purposes.

By adding together the six included items a sum is arrived at which is believed to represent moderately well the changes in the volume of personal saving from year to year. If to this sum we add the increases in the business savings of the country and subtract from the sum the increases in the national debt, the remainder may be considered a reasonably good index of the total volume of net savings in the United States. It is of course evident that it is only an index and must be expected to vary widely from the absolute total of the national savings. Unfortunately, our estimates for business savings do not cover the years preceding 1909, and our records of foreign debits and credits for the years before 1914 are extremely crude; hence the volume of saving for earlier years must be estimated on the basis of personal savings and national debt only. Building estimates form one of the important items in personal savings. These, for the earlier years, have been founded upon very tenuous assumptions. It follows, then, that while the estimates for 1909 and the later years are believed to be fairly satisfactory, the figures presented for the years preceding 1902 must be considered as having only slight value; hence it does not appear desirable to carry the computations for that period any further than is done in Table II. The figures in column D of that table serve to show something of the movements of savings during the two decades preceding the year 1909.

The fact should be noted that column K represents four-fifths of the inverse [1] of the changes in the debt of the federal government. The statement is made in the form of credits in order to make it comparable with the items in the other columns, all of which are stated in positive form. The reason for recording a part rather than the whole of this

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[1] All signs changed from plus to minus or vice versa.

TABLE II

CRITERIA REPRESENTATIVE OF NET SAVING IN THE UNITED STATES AS MEASURED IN DOLLARS OF THE GIVEN YEAR

| A | B | C | D | E | F | G | H | I | J | K |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Savings from personal income (millions) | | | | | | | |
| | | | | Increase in net value of | | | Increased supply of | | | |
| Year | Index of total net saving (C+D+K) | Estimated total saving by business enterprises[2] (millions) | Total of recorded items E+F+G +H+I+J | Assets of all insurance companies[3] | Savings Bank deposits[4] | Bonds listed on the N. Y. Stock Exchange[5] | Buildings in the United States[6] | Passenger automobiles in use[7] | Increase in private American credits abroad[8] | Four-fifths of the increase in net credits of the federal government[9] (millions) |
| 1890.......... | .... | .... | .... | .... | $99 | $4,198 | $798 | $0 | $ −48 | $ +50 |
| 1891.......... | .... | .... | $1,148 | $72 | 94 | 191 | 841 | 0 | −50 | +17 |
| 1892.......... | .... | .... | 1,279 | 81 | 81 | 175 | 994 | 1 | −52 | + 5 |
| 1893.......... | .... | .... | 921 | 71 | 18 | 139 | 747 | 1 | −54 | −37 |
| 1894.......... | .... | .... | 643 | 84 | 13 | 85 | 517 | 1 | −56 | −12 |
| 1895.......... | .... | .... | 781 | 93 | 80 | 104 | 562 | 1 | −58 | −26 |
| 1896.......... | .... | .... | 667 | 87 | 64 | 47 | 527 | 1 | −60 | −28 |
| 1897.......... | .... | .... | 661 | 105 | 79 | 88 | 447 | 2 | −60 | −32 |
| 1898.......... | .... | .... | 752 | 116 | 145 | 56 | 490 | 4 | −60 | −84 |
| 1899.......... | .... | .... | 1,056 | 143 | 192 | 156 | 618 | 6 | −60 | −11 |
| 1900.......... | .... | .... | 901 | 152 | 183 | 148 | 471 | 7 | −60 | +40 |
| 1901.......... | .... | .... | 1,184 | 168 | 150 | 220 | 696 | 9 | −60 | +54 |
| 1902.......... | .... | .... | 1,060 | 190 | 169 | 195 | 555 | 10 | −60 | +62 |
| 1903.......... | .... | .... | 1,106 | 183 | 155 | 192 | 627 | 9 | −60 | − 4 |
| 1904.......... | .... | .... | 1,457 | 243 | 163 | 356 | 731 | 24 | −60 | −36 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 1905.......... | .... | .... | 2,034 | 221 | 211 | 463 | 1,175 | 25 | −60 | + 2 |
| 1906.......... | .... | .... | 1,777 | 228 | 214 | 300 | 1,058 | 36 | −60 | +76 |
| 1907.......... | .... | .... | 1,489 | 140 | 89 | 247 | 1,027 | 46 | −60 | −10 |
| 1908.......... | .... | .... | 1,821 | 347 | 12 | 658 | 788 | 76 | −60 | −73 |
| 1909.......... | $4,707 | $2,346 | 2,401 | 279 | 119 | 642 | 1,271 | 149 | −60 | −40 |
| 1910.......... | 5,071 | 2,778 | 2,294 | 245 | 209 | 538 | 1,138 | 224 | −60 | 0 |
| 1911.......... | 3,973 | 1,938 | 2,021 | 294 | 171 | 391 | 1,029 | 196 | −60 | +14 |
| 1912.......... | 4,962 | 2,697 | 2,271 | 272 | 209 | 415 | 1,120 | 315 | −60 | − 6 |
| 1913.......... | 4,592 | 2,401 | 2,190 | 271 | 210 | 422 | 955 | 392 | −60 | +1 |
| 1914.......... | 3,937 | 1,414 | 2,552 | 283 | 136 | 352 | 785 | 431 | +565 | −29 |
| 1915.......... | 7,099 | 3,341 | 3,726 | 280 | 131 | 447 | 817 | 341 | +1,710 | +32 |
| 1916.......... | 11,810 | 6,966 | 4,985 | 387 | 377 | 236 | 1,178 | 690 | +2,117 | −141 |
| 1917.......... | 8,694 | 6,586 | 3,173 | 438 | 174 | 714 | 785 | 1,173 | −111 | −1,064 |
| 1918.......... | −1,736 | 4,907 | 2,005 | 581 | 234 | 100 | 576 | 551 | −37 | −8,648 |
| 1919.......... | .... | .... | 3,935 | 291 | 506 | 226 | 1,399 | 1,087 | +426 | −257 |

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[1] Less than one-half million.

[2] Estimated for non-agricultural industries from the amount of business savings in those industries for which records are available by using the ratio of the share of entrepreneurs and other property owners in all industries in this group to the same share in those industries recording business savings. The quantities thus estimated, when added to the savings in agriculture, give the figures in column C.

[3] Compiled from *Insurance Yearbooks* published by the Spectator Co.

[4] From the *Annual Report* of the U. S. Comptroller of the Currency, 1920, Vol. I, pp. 236–142.

[5] Compiled from the *Financial Review*. Foreign bonds and U. S. Government bonds except Panama Canal issues excluded. Foreign bonds appear in column J. The U. S. Government bonds excluded represented current expenses and not savings.

[6] A rough estimate for years previous to 1902; figures for later years based on records of building permits; depreciation and fire losses deducted.

[7] Computed on basis of figures in *Facts and Figures of the Automobile Industry*, by the National Automobile Chamber of Commerce, and in *The Automobile Industry and Its Future*, by Leonard P. Ayres.

[8] Estimated from studies in *Harvard Review of Economic Statistics*, 1919 to 1921.

[9] For description of this item and the reasons for using only four-fifths of the total, see the text.

quantity is that the use of the whole would presumably tend to give this item too much weight in the composite index. The sum of personal savings shown in column D is probably about four fifths of the actual total of personal savings in the United States, and column K has therefore been reduced in somewhat the same proportion to prevent relative overweighting. It is possible that the item of business savings should be similarly reduced, but the data in this connection are believed to be better criteria of national saving than are those entered in columns D and K, and hence no reduction has been made.

Table II makes it clear that while the volume of saving by business concerns varies directly with the waves of business activity, the extent of private saving is much less closely correlated with the economic cycle.

### G. THE TOTAL ANNUAL SAVINGS OF THE PEOPLE OF THE UNITED STATES

At first thought it might seem that if the value of the wealth at the beginning of the year were subtracted from the value of the wealth at the end of the year, the net result would be the annual savings measured in terms of money. More careful consideration indicates, however, that because of the manner in which wealth is currently valued, a figure arrived at in this manner has little significance.

As previously pointed out, the current valuation of durable goods depends as much upon the views generally prevailing at the moment concerning the future course of prices, interest rates, etc., as it does upon any definitely known facts concerning present income or physical wealth. The value of existing wealth, therefore, varies greatly with every change of community opinion, with every wave of pessimism or optimism. It seems absurd, however, to say that because people have suddenly become more hopeful, the nation has thereby accumulated billions of savings. It appears, therefore, that estimates of the national wealth can be safely utilized only as starting points upon which to base estimates of national savings, and that a rather roundabout calculation is necessary to arrive at anything approaching a logical estimate of the savings of the country.

The calculation here presented is founded upon the following assumptions:

1. Saving should be measured as a differential between valuations derived by a constant mode of reasoning from trends of income and should not be calculated upon the basis of merely momentary conditions and opinions.

2. The present value of wealth depends upon anticipations concerning income to be derived from present wealth in the future and not

at all upon estimates of income to be obtained in the future as payment for personal services.

3. The average ratio between wealth and income from property and entrepreneurial efforts over the period 1909 to 1915 inclusive probably furnishes a moderately good criterion of the ratio which the beliefs and feelings of the community normally fix between these quantities. Greater accuracy can be secured when records for more years become available. The ratios for 1916 to 1918 as shown in Table III, column D, have not been used in computing the average, since it appears that the unusual price inflation made them abnormally low.

4. Total national saving probably bears an approximately constant ratio to an index of business, private, and public savings combined.

The principles just enunciated are exemplified in Tables III and IV. All values have been reduced to the price level of 1913 in order to eliminate fictitious increases in wealth due to changes in the value of money.

The purpose of Table III is to ascertain the total national saving for the nine-year period, 1909–18, as measured in terms of dollars of 1913. Since the normal ratio of the current value of all property in the United States to the annual income of entrepreneurs and other property owners seems to be around thirteen to one, it follows that if currency changes affect about equally the values of direct and indirect (consumption and production) goods, the wealth of the country, when converted into terms of constant purchasing power, ought to be approximately thirteen times the income of the above-mentioned classes, when such income is expressed likewise in terms of constant purchasing power. It is indeed true that for any given year a ratio based upon physical quantities of wealth and physical quantities of income probably would vary greatly owing to differences in climatic conditions or to disturbances in industrial conditions. However, it seems probable that a moving average of such ratios calculated on a three or four year period would fluctuate but slightly. It is such a ratio that we are attempting to approximate by averaging the ratios in column D for the years 1909 to 1915.

Evidently the application of this average ratio to the purchasing power income for different years will scarcely give results for individual years which possess much merit, but the chances are that the error in any given year will be too small to affect materially the total difference between the respective wealth estimates for the end of 1909 and the end of 1918. The figure $46,115,000,000, calculated in the manner described,[1] may then prove to be fairly close to the actual increase in

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[1] See Table III, column F.

### TABLE III

### A PRELIMINARY ESTIMATE OF THE WEALTH OF THE UNITED STATES MEASURED IN DOLLARS HAVING THE SAME PURCHASING POWER AS IN 1913

| A | B | C | D | E | F |
|---|---|---|---|---|---|
| Year | Total income of entrepreneurs and other property owners[1] (millions of current dollars) | Wealth at close of year in current money[2] (millions) | Ratio of C to B | Purchasing power of total income of entrepreneurs and other property owners at prices of 1913[1] (millions) | Preliminary estimate in terms of dollars of 1913 of the wealth at the close of the year. (E times the average ratio of C to B) (millions) |
| 1909 | $14,004 | $172,125 | 12.291 | $14,635 | $188,674 |
| 1910 | 14,901 | 183,944 | 12.344 | 15,234 | |
| 1911 | 14,099 | 185,922 | 13.187 | 14,319 | ...... |
| 1912 | 15,390 | 195,200 | 12.684 | 15,457 | ...... |
| 1913 | 15,634 | 201,271 | 12.874 | 15,634 | ...... |
| 1914 | 14,849 | 203,048 | 13.674 | 14,699 | ...... |
| 1915 | 16,565 | 218,571 | 13.195 | 16,359 | ...... |
| 1916 | 22,303 | 246,139 | 11.036 | 20,253 | ...... |
| 1917 | 26,869 | 272,147 | 10.129 | 20,830 | ...... |
| 1918 | 27,355 | 294,145 | 10.753 | 18,212 | 234,789 |
| 1919 | .... | .... | .... | .... | ...... |
| | Average for 1909 to 1915 inclusive = 12.892 | | | Increase in wealth in nine years = $46,115 | |

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[1] Revision according to information at hand on June 25, 1922, of estimates presented by the National Bureau of Economic Research in *Income in the United States.*

[2] See Table I, last column, this JOURNAL, September, 1922, p. 322.

wealth during the nine year period, if such wealth is, in each year, measured in terms of 1913 dollars. Since this estimate is the figure upon which all later results depend, it is manifestly worth while to test its accuracy with as much care as possible. It represents an increase in wealth of about 24.4 per cent, which increase is equivalent to about one seventh of the total income during the nine years. This seems to be a surprisingly large fraction. Is it not probable that it is so large merely because of some error in the basic figures?

Manifestly, if the calculated increase in wealth, as shown in column C of Table III, is greater than the facts warrant, it will make the difference between 1909 and 1918 too great. As a matter of fact, nothing in the mode of deriving the indexes used in computing Table I causes us to suspect that their slope is materially at fault.

But even if the slope of the items in column C is correct, if the absolute size of the items throughout is exaggerated the distance between the extremes will be exaggerated in the same degree, and an error will arise from this source. As a matter of fact, it appears more probable that the Census of Wealth, in compiling property values, has omitted many very valuable items, such as parks and other public property, from its totals than that it has duplicated other items of value. The chances are, then, that the volume of saving is not exaggerated because of this reason.

If the ratios shown in Table III, column D, for the last three years are included in the average, that figure will be reduced to approximately 12.2 instead of 12.9. Such a change would affect the results by only about 5 per cent. Evidently errors from this source cannot be considered of major importance.

Although the evidence at hand shows no reason for doubting that 46.1 billions of dollars of 1913 value represents approximately the extent of the saving during the nine years, it nevertheless seems worth while to test the accuracy of this figure by another set of computations. If wealth has increased at any such rate some evidence of the fact should be shown not only by the increase in the value of property rights represented by securities, but also by the increase in those tangible physical assets, the numbers or quantities of which have been recorded from time to time.

Table IV is made up of a collection of data which indicate the changes in the quantity of a limited number of items which are used as criteria because they are the best available. It is evident that they do not cover all of the important categories of wealth and that the units are not exactly comparable in nature at the two dates.

It is probable, however, that while the quality of some units—for

## TABLE IV

### FRACTION OF INCREASE DURING NINE OR TEN YEARS IN THE SIZE OF ITEMS REPRESENTING THE VOLUME OF PHYSICAL WEALTH IN THE CONTINENTAL UNITED STATES

| Kinds of wealth | Beginning of period | | End of period | | Weight[12] | Product in millions | |
|---|---|---|---|---|---|---|---|
| | Year | Amount | Year | Amount | | Beginning of period | End of period |
| Acreage of all crops (millions)[1] | 1909 | 311.3 | 1918 | 365.2 | 70 | 21,791 | 25,564 |
| Improved farm acreage (millions)[2] | 1910 | 478.5 | 1920 | 507. | 30 | 14,355 | 15,210 |
| Woodland in farms (millions of acres)[2] | 1910 | 190.9 | 1920 | 168.6 | 20 | 3,818 | 3,372 |
| Farm implements and machinery[3] | 1909 | 1,172.9 | 1918 | 1,800.7 | 3 | 3,519 | 5,402 |
| Total farm land, machinery and agricultural products | .... | .... | .... | .... | .... | 43,483 | 49,548 |
| Poultry on farms (millions)[2] | 1910 | 295.9 | 1920 | 372.8 | 1 | 296 | 373 |
| Horses, mules and cattle (thousands)[2] | 1910 | 91,179. | 1920 | 96,600. | 90 | 8,206 | 8,694 |
| Sheep, goats and swine (millions)[2] | 1910 | 115.3 | 1920 | 101. | 9 | 1,038 | 909 |
| Total live stock | .... | .... | .... | .... | .... | 9,540 | 9,976 |
| Gold coin and bullion in Treasury (millions of dollars)[4] | 1909 | 1,642. | 1918 | 3,076. | 1 | 1,642 | 3,076 |
| Freight cars (thousands)[4] | 1909 | 2,173. | 1918 | 2,516. | 2,500 | 5,432 | 6,290 |
| Locomotive tractive power (millions of pounds)[4] | 1909 | 1,504. | 1918 | 2,221. | 1 | 1,504 | 2,221 |
| Railways (thousands of miles)[4] | 1909 | 244.1 | 1918 | 264.2 | 15,000 | 3,661 | 3,963 |
| Passenger cars in service on railways[4] | 1909 | 45,584. | 1918 | 56,505. | 8,000 | 365 | 452 |
| Total, railways and equipment[5] | .... | .... | .... | .... | .... | 10,962 | 12,926 |
| Telegraph wire (thousands of miles)[4][5] | 1907 | 1,578. | 1917 | 1,890. | 100 | 158 | 189 |
| Ocean cable (miles)[4][5] | 1907 | 46,301. | 1917 | 71,251. | 2,000 | 93 | 143 |
| American Telephone Company wire operated (thousands of miles)[5][6] | 1909 | 9,831. | 1918 | 22,610. | 150 | 1,475 | 3,391 |
| Electric railways (miles)[6] | 1909 | 40,490. | 1918 | 48,484. | 80,000 | 3,239 | 3,879 |
| Electric railway cars (number)[6] | 1909 | 91,153. | 1918 | 101,734. | 20,000 | 1,823 | 2,035 |
| Primary electric horsepower (thousands)[7] | 1907 | 618. | 1917 | 17,137. | 260 | 1,721 | 4,456 |
| Total public utilities | .... | .... | .... | .... | .... | 8,509 | 14,093 |
| Horsepower used in factories of selected states (thousands)[8] | 1909 | 1,207. | 1919 | 1,768. | 30,000 | 36,210 | 53,040 |
| Number of motor cars registered (thousands)[9] | 1909 | 300. | 1918 | 6,147. | 400 | 120 | 2,459 |
| Tonnage of merchant marine (thousands)[4] | 1909 | 7,389. | 1918 | 9,925. | 70 | 517 | 695 |
| Navy tonnage in commission (thousands)[10] | 1910 | 1,097. | 1918 | 1,754. | 800 | 878 | 1,403 |
| Pupils in public schools (thousands)[4][5] | 1909 | 17,506. | 1918 | 20,854. | 200 | 3,501 | 4,171 |
| Mileage of improved roads (thousands) | 1909 | 190.[13] | 1919 | 296. | 6,000[14] | 1,140 | 1,776 |
| Standing timber (billions of board feet) | 1911 | 3,243.[15] | 1920 | 2,214.[16] | .0015 | 4,865 | 3,321 |
| Property rights in foreign countries[11] | 1909 | −1,740. | 1918 | 2,900. | 1 | −1,740 | 2,900 |
| Total | | | | | | $119,627 | $159,384 |
| Index—base, beginning of period | | | | | | 1.000 | 1.332 |

## FOOTNOTES TO TABLE IV ON PAGE 464

[1] *Yearbook of Agriculture*, 1920, p. 808.

[2] U. S. Census; Preliminary Reports for 1920.

[3] Value in millions of dollars at prices of 1914; computed from Census figures.

[4] *Statistical Abstract of the United States*, for 1920, pp. 325, 335, 367, 594, 811, and 818.

[5] Used as a measure of the total supply of equipment.

[6] *Statistical Abstract of the United States* for various years.

[7] United States Census of Central Electric Light and Power Stations, 1917, p. 49.

[8] United States Census of Manufactures, 1909, Vol. VIII, p. 511 and the 1919 Census Reports for sample States.

[9] *Automotive Industries;* January 15, 1920, p. 111.

[10] *Annual Reports* of the Secretary of the Navy.

[11] Items in Table I divided by indexes of wholesale prices.

[12] Weights have been chosen with a view to making the totals for the given groups of items roughly equal to the total value of this variety of wealth in 1918 as estimated in Table I. The weights assigned to the respective items indicate the relative importance attached to each as an indicator.

[13] United States Office of Public Roads, Bulletin 41, p. 41.

[14] *Statistical Abstract of the United States* for 1918, p. 297.

[15] Estimated from United States Forest Service Bulletin, *Our Timber Supply*, 1914.

[16] Greeley, William B., *Timber Depletion and the Answer*, United States Department of Agriculture, Circular 112.

example, freight cars—has improved, others like woodland may have grown poorer. The errors are, then, presumably to a large degree compensating.

Unfortunately, data are, in some instances, not available for 1909 and 1918, the two specific years desired. It has therefore been necessary in a number of cases to take in the decade 1909 to 1919. The inclusion of the extra year will of course make the computed percentage of increase for the period slightly too large.

The weighted average obtained by this method indicates a wealth increase for the period of about 33 per cent. If this be reduced by about one-fifteenth to allow for the error just mentioned, the estimated increase is reduced to 31 per cent, which is even larger than that obtained by the operations recorded in Table III. True, the weights used are necessarily more or less arbitrary, and experiment shows that a shift to other weights which seem almost as logical may change this result by as much as 2 or 3 per cent. Even after allowing for this degree of divergence, the estimate that the people of the country actually saved $46,115,000,000 in the nine years ending December 31, 1918, still seems more in danger of being too low than too high.

It is undoubtedly true that much saving can be accomplished without abstinence, for in the case of very wealthy persons it may be easier to save a large fraction of the income than to spend it all. However, such saving plays but a minor rôle in the national total. Certainly, almost anyone could spend $50,000 a year without difficulty. The total income of persons receiving more than that amount annually was, however, only $2,730,000,000 in 1918.[1] If we deduct from the sum just mentioned $50,000 for each of the persons in the higher income classes, the remainder will be only $657,000,000, or less than a seventh of the normal annual savings of the people of the nation. Although, then, much of the actual saving may cause relatively little sacrifice, it is evidently not true that any considerable proportion of the huge accumulation in the nation comes about simply because it is easier to save the income than to spend it.

Having estimated the total savings of the nation for the decade, the problem still remains of apportioning this sum among the various years of the period. No accurate method of accomplishing this end is available, but it seems probable that if the amount is assumed to be a constant multiple of the index of saving derived in Table II, the error in the resulting products will not be unduly large. This process has been carried out in Table V.

Table V brings out some interesting facts. It appears that the

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[1] See *Income in the United States*, Vol. I, Table 27.

## TABLE V

## AN ESTIMATE OF THE NET SAVINGS OF THE UNITED STATES AND ITS PEOPLE

| A | B | C | D | E | F | G | H |
|---|---|---|---|---|---|---|---|
| Year | Total national income measured in 1913 dollars (millions) | Total national income measured in dollars of given year [1] (millions) | Index of saving in the United States [2] | Ratio of income saved to index of saving [4] | Total national savings measured in dollars of current year (millions) (D×E) | Fraction of income saved $\frac{F}{C}$ | Total income saved measured in dollars of 1913 (millions) (B×G) |
| 1909 | $30,608 | $29,259 | $4,707 | 1.0624 | $5,001 | .1709 | $5,231 |
| 1910 | 32,176 | 31,471 | 5,071 | 1.0624 | 5,387 | .1712 | 5,509 |
| 1911 | 31,397 | 30,904 | 3,973 | 1.0624 | 4,221 | .1366 | 4,289 |
| 1912 | 33,985 | 33,807 | 4,962 | 1.0624 | 5,272 | .1559 | 5,298 |
| 1913 | 35,436 | 35,436 | 4,592 | 1.0624 | 4,879 | .1377 | 4,880 |
| 1914 | 33,067 | 33,401 | 3,937 | 1.0624 | 4,183 | .1252 | 4,140 |
| 1915 | 35,150 | 35,920 | 7,099 | 1.0624 | 7,542 | .2100 | 7,381 |
| 1916 | 41,669 | 45,861 | 11,810 | 1.0624 | 12,547 | .2736 | 11,401 [7] |
| 1917 | 42,377 | 54,664 | 8,694 | 1.0624 | 9,237 | .1690 | 7,162 [7] |
| 1918 | 38,830 | 59,930 | −1,736 | 1.0624 | −1,844 | −.0308 | −1,196 [7] |
| Total 1910–18 | $324,095 | $361,394 | $48,402 | Period | 1909–18 | .1561 [5] | $54,095 [6] |

$\frac{\text{Savings for 1910–18 at 1913 prices}}{\text{Income for 1910–18 at 1913 prices}} = \frac{\$46,115\,[3]}{\$324,095} = 0.14229 =$ Fraction of income saved.

$0.14229 \times \$361,394 = \$51,423 =$ Total income saved, in millions of current dollars.

$\frac{51,423}{48,402} = 1.0624 =$ Ratio of income saved to saving index.

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[1] Revision, according to information at hand on June 25, 1922, of estimates presented in *Income in the United States.*

[2] See Table II, column B.

[3] See Table III, column F.

[4] See computation at foot of this table.

[5] $\frac{\text{Sum of F}}{\text{Sum of C}}$.

[6] Total of above items.

[7] See the text for a discussion of possible adjustments in these items.

normal fraction of the national income saved is about one-seventh;[1] but that in a year of exceptional business prosperity like 1916 this fraction increased to one-fourth, while the war expenditures of 1918 actually used up not only all of the current income but also a very small fraction of the previously existing wealth of the country. If we measure values in terms of dollars of 1913 purchasing power, the saving of the country, during the decade under discussion, amounted to about $55 annually for each inhabitant of the United States.

Most readers will, presumably, not be surprised to learn that there was no net saving in the war year of 1918, but they may be inclined to doubt that the people of the nation actually added to their wealth in 1916 more than 12½ billions of dollars. Is such a figure reasonable? This question can best be answered by studying the statistics of total income measured in dollars of uniform purchasing power.

The income of all the employees in the Continental United States had been averaging about 19 billions a year for several years preceding 1916. In that year it increased suddenly to 21½ billions. If the savings of this class in ordinary years amounted to one billion dollars, it seems that in 1916 they may easily have laid aside 20 per cent of this extra pay, thus arriving at a total of 1½ billions.

Apparently, in the earlier years of the decade, entrepreneurs and other property owners had been in the habit of spending about 10½ billions and saving about 4½ billions a year. If in 1916 they spent 10½ billions as usual, there still remained nearly 10 billions for savings. In this case the 11.4 billions of savings would be approximately accounted for.

Unfortunately, we have no accurate evidence concerning the respective total savings of entrepreneurs and employees; but if the line of reasoning given above is correct, some interesting deductions follow. If we speak in terms of 1913 prices throughout, the 27,000,000 employees probably saved during the decade 1909–18 from their total income of 189 billions of dollars some 10½ billions of dollars or an annual average of $40 each, while each spent some $650 a year to support himself and his dependents. During the same period, the 6,400,000 farmers of the country and an unknown number of urban owners of farm land and farm mortgages received together some 54 billions of dollars. The average farmer's income must, then, have been noticeably below $850 per annum.[2] Out of the net value product of agriculture, the savings amounted to about 6,713 millions of dollars [2] or over $100 a farmer per annum.

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[1] The fact should be kept in mind that this total includes additions to the stock of consumption goods as well as improvements in business equipment.

[2] Recent estimate by the National Bureau of Economic Research.

The average farmer therefore spent for himself and his dependents something materially less than $750 per annum, a sum which, however, in comparison with the average income of other entrepreneurs is not quite so meager as it appears, since a considerable share of the farmer's income consists of farm products consumed at home and these farm products are valued at farm prices which are on the average not more than half as high as the urban resident must pay for the same articles.

Aside from the farmers there are in the country about 3,300,000 entrepreneurs, and these receive on the average a total annual income of a trifle over 11 billions of dollars, or nearly $3,400 each per annum.[1] Out of this total these entrepreneurs probably saved, either directly or through their business enterprises, some 37 billions or slightly over $1,100 per man annually, leaving something under $2,300 each which they spent yearly for the consumption goods used by themselves and their families.

### TABLE VI

### THE WEALTH OF THE UNITED STATES, MEASURED IN DOLLARS HAVING THE SAME PURCHASING POWER AS IN 1913

Computed according to mathematical rules with unchanging principles of valuation applied throughout.
Base, January 1, 1912

| A | B | C | D |
|---|---|---|---|
| Beginning of year | Wealth at beginning of 1912 measured in dollars of 1913 value[1] (millions) | Net saving during year measured in dollars of 1913 value[2] (millions) | Wealth at beginning of year measured in dollars of 1913 value[3] (millions) |
| 1909 | ...... | $5,231 | $172,380 |
| 1910 | ...... | 5,509 | 177,611 |
| 1911 | ...... | 4,289 | 183,120 |
| 1912 | $187,409 | 5,298 | 187,409 |
| 1913 | ...... | 4,880 | 192,707 |
| 1914 | ...... | 4,140 | 197,587 |
| 1915 | ...... | 7,381 | 201,727 |
| 1916 | ...... | 11,401 | 209,108 |
| 1917 | ...... | 7,162 | 220,509 |
| 1918 | ...... | −1,196 | 227,671 |
| 1919 | ...... | ...... | 226,475 |

[1] When computed from the purchasing power of the total income, it appears that the value in current money of the wealth on January 1, 1912, should be multiplied by 1.008 in order to arrive at the value of the wealth on January 1, 1912, in terms of the prices of January 1, 1913.
$185,922,000,000 × 1.008 = $187,409,376,000.
For data see Table I and columns B and C of Table V.

[2] See Table V, column H.

[3] Computed by addition or subtraction from columns B and C.

If the estimates of saving shown in Table V are accurate, and if the Census gives the correct total value for the national wealth in 1912, then the items in Table VI cannot be materially in error.

Although it must be admitted that the figures in the last column of

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[1] See Table III, column E.

Table VI do not correspond to customary ideas of value, it is believed, nevertheless, that they represent as closely as the accuracy of the data will permit an index of the increase during the decade in wealth, if wealth is thought of rather as a mass of goods than as an aggregate of values. When viewed from this standpoint it appears that wealth grew steadily throughout the decade, with the exception of the last year considered, and that the total at the end of the period was about one-third greater than that at the beginning.

TABLE VII

A COMPARISON OF TOTAL SAVING WITH SAVING BY BUSINESS CONCERNS

For the Continental United States

| A | B | C | D |
|---|---|---|---|
| Year | Total savings of nation[1] (millions) | Business savings[2] (millions) | Per cent of total saved by business concerns $\frac{100C}{B}$ |
| 1909 | $5,001 | $2,346 | 46.91 |
| 1910 | 5,387 | 2,778 | 51.57 |
| 1911 | 4,221 | 1,938 | 45.91 |
| 1912 | 5,272 | 2,697 | 51.16 |
| 1913 | 4,879 | 2,401 | 49.21 |
| 1914 | 4,183 | 1,414 | 33.80 |
| 1915 | 7,542 | 3,341 | 44.30 |
| 1916 | 12,547 | 6,966 | 55.52 |
| 1917 | 9,237 | 6,586 | 71.30 |
| 1918 | −1,844 | 4,907 | [3] |

[1] See Table V, column F.
[2] See Table II, column C.
[3] Business savings are more than total, which is negative.

The calculations recorded in Table VII indicate that the business enterprises of the country are normally responsible for about 40 per cent of the entire saving of the nation and, as might be expected, that this percentage increases in years of business prosperity and diminishes in times of depression.

# LAW OF GROWTH IN FORECASTING DEMAND

### By Raymond B. Prescott

A number of years ago in plotting the growth of the population in the United States as a whole, and also in several of the older states of the Union, I found that they all traced a similar curve. While reading Tarde's *Laws of Imitation* I noticed that he mentioned a similar curve for the growth of railroads and of tobacco consumption in France. This led me to plot the growth of several products in the United States. Again I found a similar curve. I noted also that all the data plotted were of products that were a direct function of population. These results seemed to indicate that there is a general law of growth that would fit the growth of population, and also some products, perhaps all, that are a direct function of the growth of population.

The curve seems to pass through four phases, indicating that population and industry perhaps pass through the same phases or periods in the course of their development. An investigation of the growth of several industries seemed further to confirm this idea. The four stages seemed to be[1]:

(1) Period of experimentation.

(2) Period of growth into the social fabric.

(3) Through the point where the growth increases but at a diminishing rate.

(4) Period of stability.

If this growth is fundamental and common for all industries whose products are a direct function of the growth of population, and if this growth could be expressed by a general type of equation, it is not difficult to conceive that when one part of the growth is known the others can be determined. To explain past performances and predict the future are not different operations. They are the same operations working in opposite directions, one from effect to cause and the other from cause to effect.

During the period of experimentation the permanent success of an industry is doubtful because man, being a creature of habit, dislikes to have his routine changed. He accepts very slowly anything that tends to alter his course from its accustomed path; consequently he opposes the object that is tending to vary his usual habits. The success of the industry depends upon how well the resisting habits of man are overcome. Some individuals are more easily overcome than others, and soon become part of the force working to overcome the general resistance.

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[1] I am indebted to Mr. Harry Tipper, of *Automotive Industries*, for aid in defining the four stages.

If the industry succeeds in overcoming man's natural resistance to having his habits disturbed, then progress of the industry enters into the period of growth into the social fabric, where it either becomes a part of the daily life of man or fails. Rate of growth varies with every industry, the rate depending upon the industry's adaptability to the economic and social life of man, which in turn depends upon the characteristics of the product and the incentive for its use created by man himself.

During the course of its progress an industry finally reaches a point where its growth continues to increase but at a decreasing rate, and so on into the period of stability where it becomes part of the economic and social life of man.

Merely to know that such growth is a possible fact is not enough. To make this knowledge really useful it is necessary to measure this growth. Before this can be done it is necessary to have a clear conception of what constitutes and influences this growth.

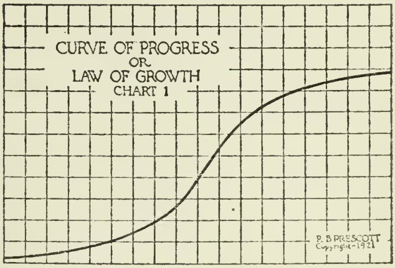
Every individual exerts some influence upon the growth of an industry. These influences vary in intensity and quality, from an extremely favorable attitude to one strongly unfavorable. The yearly summation of these favorable or unfavorable influences determines the progress of an industry. Some of these influences are more vital in shaping the course of the industry than others; some are so slight that they hardly make any impression at all. It is the combination of these many influences each year that finally determines whether or not the industry grows.

These influences may be grouped under two heads, "internal" and "external." The internal can be controlled to a large extent, and the external can be created by the proper action of the internal influences. If the internal influences are very strong, they naturally create more favorable external influences, sometimes called "good-will."

Strong internal influences are created by having a strong organization, good products, and sound policies. Of course there are many factors that enter into these broad divisions which permit of many combinations of favorable or unfavorable influences. One of the most common is the personality of the executives upon whose shoulders lies the responsibility for selecting the members of an organization, developing the product, and creating the policies under which the industry is operated.

In a large industry some companies make real progress while others remain stationary. The successful company is one in which internal influences have been combined, resulting in a strong organization with a concomitant creation of favorable external influences. The degree to which the favorable external influences are created depends entirely upon the extent to which the favorable internal influences dominate the combination.

If an organization has a good product that is properly manufactured, advertised, and sold, a demand will naturally develop for the product and good-will will be created in the minds of users. In order that an industry may make steady progress under our competitive system, it must continue to have strong internal influences which are constantly creating strong external influences; otherwise it would retrogress.



The result of the summation of these many influences is measured in the yearly volume of business transacted, whether it is in physical units or in value. The geographical expression of this growth is shown by the curve traced in Chart 1. This curve seems to be fundamental for all industries that are either directly or indirectly functions of population; *i. e.*, whose growth depends directly or indirectly upon the ability of the people to consume their products. Every country may have a different rate of growth, and so may every industry, because no two industries have the same combination of influences. They will trace the same type of curve, however, even though the rate of growth is different.

It seemed as though it might be possible to obtain a general equation by which one could express and measure this phenomenon of growth as shown in Chart 1. After I had experimented with several equations that would fit the conditions for part of the curve, the Gompertz curve[1] was suggested to me. I experimented with this curve, first with population and then with a number of products, with quite satisfactory results, which indicated that it might be possible to forecast the probable growth of an industry and, by so doing, the probable demand for the product. Of course it must be realized that even if this equation will forecast probable or normal demand for a product, the business cycle must be taken into account before the actual demand can be forecast for any particular year. I believe that this equation can be used to forecast the normal growth of an industry over a period of time, though the yearly functions may be above or below this curve. It is the average of these variations that determines the growth.

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[1] I am indebted to Professor Harry C. Carver, of the University of Michigan, for suggesting the Gompertz equation as a curve having the desired trace, and to Professor Henry L. Moore, of Columbia University, for further assistance in its use.

The equation[1] is as follows:

$$y = ab^{c^x}. \tag{1}$$

$$\text{Log } Y = \text{Log } A + c^x \text{ Log } B. \tag{2}$$

Let now $x$ become successively $x_1$, $x_1+1+ \quad . \quad . \quad . \quad +x_1+n-1$. Then taking the sums we get

$$\sum_{x}^{x+n-1} Y = nA(c^x + c^{x+1} + \quad . \quad . \quad . \quad + c^{x+n-1})B. \tag{3}$$

The series of $c$ is in geometrical progression.

Such a series is:

$$S = \alpha + \alpha\beta + \alpha\beta^2 + \quad . \quad . \quad . \quad + \alpha\beta^{n-1}$$

$$\therefore \beta S = \alpha\beta + \alpha\beta^2 + \quad . \quad . \quad . \quad + \alpha\beta^{n-1} + \alpha\beta^n$$

$$\therefore S(1-\beta) = \alpha(1-\beta^n) \text{ and}$$

$$S = \alpha\frac{(1-\beta^n)}{(1-\beta)}.$$

Consequently the sum of the $c$ series is

$$S = c^x\frac{(1-c^n)}{1-c} = c^x\frac{(c^n-1)}{(c-1)},$$

and we may write (3)

$$\sum_{x}^{x+n-1} Y = nA + c^x\frac{(c^n-1)}{(c-1)}B. \tag{4}$$

This equation (4) will enable us to find the constants in the formula.

There are three constants in the equation, and we therefore need to have three simultaneous equations. If we divide up our observations into three equal parts we have, using equation

$$\sum_{x}^{x+n-1} Y = nA + c^x\frac{(c^n-1)}{(c-1)}B \tag{4}$$

$$\sum_{x+n}^{x+2n-1} Y = nA + c^{x+n}\frac{(c^n-1)}{(c-1)}B \tag{5}$$

$$\sum_{x+2n}^{x+3n-1} Y = nA + c^{x+2n}\frac{(c^n-1)}{(c-1)}B.$$

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[1] As far as I have been able to learn, this equation has never been fitted to economic data before.

Differencing both sides of these equations, we get

$$\sum_{x+2n}^{x+3n-1} Y - \sum_{x+n}^{x+2n-1} Y = c^{x+n}\frac{(c^n-1)^2}{(c-1)}B$$

$$\sum_{x+n}^{x+2n-1} Y - \sum_{x}^{x+n-1} Y = c^{x}\frac{(c^n-1)^2}{(c-1)}B.$$

These two equations may be written

$$\begin{aligned} \Delta \sum_{x+n}^{x+2n-1} Y &= c^{x+n}\frac{(c^n-1)^2}{(c-1)}B \\ \Delta \sum_{x}^{x+n-1} Y &= c^{x}\frac{(c^n-1)^2}{(c-1)}B. \end{aligned} \tag{6}$$

Now dividing both sides of the first equations in (6) by the corresponding side of the second equations in (6) we get

$$\frac{\Delta \sum_{x+n}^{x+2n-1} Y}{\Delta \sum_{x}^{x+n-1} Y} = c^n.$$

Take the logarithms of both sides

$$\log \Delta \sum_{x+n}^{x+2n-1} Y - \log \Delta \sum_{x}^{x+\mathrm{n}-1} Y = n \log c. \tag{7}$$

Equation (7) enables us to compute at once the value of $c$. We may then find ($b$) from either of the equations in (6). Finally $A$ may be obtained from (2).[1]

In studying the factors which influence the law of growth of populations or of an industry that is a direct function of population, motor vehicle registration data were fitted to the previously mentioned equation, as I was particularly interested in the automotive industry.

It was thought that if results obtained by fitting these data to the equation were reasonably satisfactory, it would create possibilities for reaching the solution of many problems that face the industry, the principal problem being to determine the number of motor vehicles that can be absorbed in the United States yearly.

The automotive industry is of comparatively recent origin; hence data for only a few years are available, and the results of the research probably cannot be considered to have the same degree of accuracy in measuring the law of growth, or in forecasting over as long a period, as they would have if data for an older and more firmly established industry, which has entered the period of stability, had been used. The results of the experiment may be seen in Chart 2 which shows the number of vehicles registered yearly, with the year 1921 as a forecast. The curve is extended to 1930 for the purpose of seeing how soon motor vehicle registrations will approximate the same rate of growth as population. It is not my intention that there should be considered seriously any forecast of more than a year or two, or perhaps three years beyond the data used, which in this case was up to 1920.

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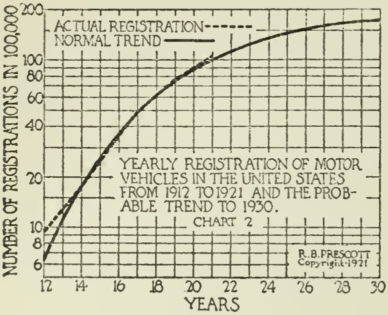
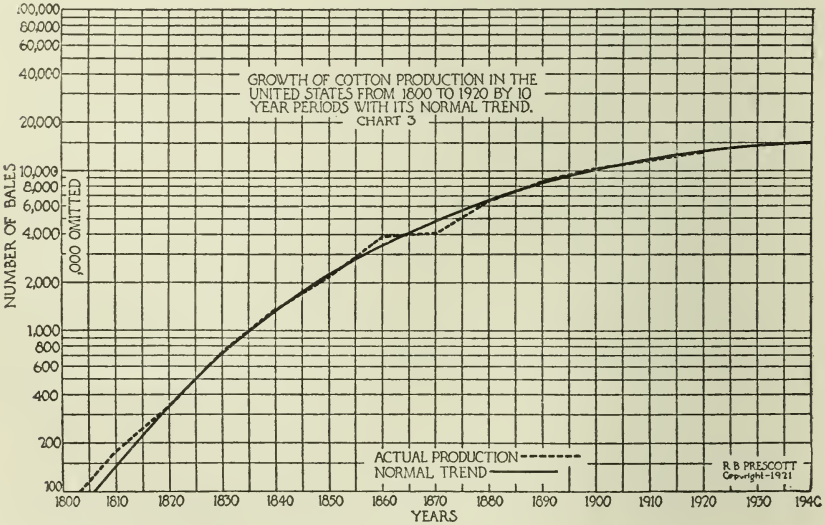
[1] The equation was first published in *Automotive Industries*, Nov. 17, 1921.



To show that with more extensive data it is possible to determine better the law of growth and to forecast more accurately for a longer period than with the data over a short period as in the case of the automotive industry, an older industry was used. For the experiment the total production of cotton was used for each tenth year beginning with 1820 and ending with 1890. The available data were then fitted to the above equation and the curve plotted as shown in Chart 3. The curve was then extended to 1920, a period of thirty years beyond which any data were assumed to have been available, with the pleasing results of only about a 2 per cent error in 1920. The forecasts for the three years were as follows:



| | Actual | Graduated |
|---|---|---|
| 1900 | 9,863,000 | 10,123,000 |
| 1910 | 11,600;000 | 11,608,000 |
| 1920 | 13,261,000 | 12,987,000 |

These results may be just a coincidence; but it hardly seems probable that three years, ten years apart, could be forecast as accurately and be merely a coincidence.

Many of the organizations in the industries that have kept any statistics have confined them almost entirely to their respective companies. That is all right as far as it goes, but it is only the beginning. Data showing only the yearly growth of an organization with respect to itself give little information as to what the real demand for the product is, or what percentage of the total business it is securing. An organization must know its progress with respect to the whole industry and what percentage of the total yearly business it has been getting over a period of years in order to obtain the proper perspective of its place in the industry. Such information will permit the executives of an organization to see the true position of the company and to determine its growth with respect to the whole industry.

To apply this equation to a single company would be just as dangerous as it would be for an insurance company to try to insure each individual without any knowledge of the law of probability. In an industry composed of a number of companies there is an opportunity to use the law of large numbers, which large number is the summation of their yearly volume of business. By use of these numbers an average can be forecast, and the probable error of variation and the percentage of the total business that a company has had over a period of time can be determined. On that basis the percentage of business that a company will secure for a year or two in advance can be forecast within probable limits of variation. This variation can no doubt be decreased if the demand for the product of any industry is adjusted to the business cycle.

By this method of forecasting the possible demand an industry can also determine the yearly probable demand for its product, and the various companies that constitute the industry can determine their respective positions. They should then confine their efforts to supplying that total, and should not over-expand, as has been the custom of the past. If this condition could be realized, it probably would eliminate some of the variation in the business cycle and make the probable error in forecasts much smaller.

It is hoped that large industries will realize that in forecasting the demand for a product for a whole industry there is a maximum that the country can consume yearly, and that as the price increases, the possible demand becomes more and more limited. It has been found that by dividing the sales of cars into price classes, it is possible to forecast the probable percentage of the total sales in each group. For example, the probable sales for 1921 in each price class were forecasted in February of 1921; at the end of the year the actual sales were determined and the following comparison was made:

| | Under $1,000 | $1,000–$1,999 | $2,000–$2,999 | $3,000–$3,999 | $4,000 and over |
|---|---|---|---|---|---|
| Calculated percentage.............. | 75.0 | 19 | 4.0 | 1.0 | 1 |
| Actual percentage.................. | 73.5 | 20 | 4.2 | 1.5 | 1 |

Professor H. L. Moore, of Columbia University, published in the March issue of this Journal an equation which probably will give a much more refined method of forecasting the number of cars that can be sold in each price class, or as a matter of fact, at any price. I am at present experimenting with this method as applied to automotive data. It is too early to say what the results will be.

In a period of time the production of every company in a large industry bears a certain relationship to the total production, and the yearly rates of its business compared to the total business of the industry over a certain period of time should give that company a clear idea of its relative position and the progress it has made.

Let us assume that a company has acquired the total production of its specific industry and has determined its yearly rate of business over a period of time, the more years the better. It then uses this growth curve or some other method to forecast the probable demand for the next year or so, or even three years in advance. The company knows its yearly percentage of business, from which it is possible to forecast the probable percentage it will acquire in the next year or so, the third year being used only in a general way as a possible tendency. In the automotive industry it is even possible to carry this further by using the car registrations in each geographical division to forecast the probable sales of cars by makes or price classes in each of the nine geographical divisions used in the United States census chart. By adding the demand for any make of car in all the geographical divisions, it should check very closely with the demand determined from the production figures as outlined above.

With the potential demand determined, it is possible for a company to lay out its sales quotas—production schedules, purchases of materials, and financial arrangements and budgets—for each department for a year in advance and to adjust them each quarter according to the business cycle.

Manufacturers who employ this method or a similar one certainly will be in a much stronger position than manufacturers who continue to use the present inefficient methods. Facts show that no established company can acquire a great increase in its yearly volume except under the following conditions: (1) Introduction of a far superior product; (2) considerable reduction in price of an old established product.

A company may acquire a steady yearly increase in business by continually employing better methods than its competitors, or in other words, creating more favorable influences, both internal and external.

When scientific methods of forecasting future demands for products are generally employed in the basic industries, probably the variation in the business cycle will be considerably less. This would partially eliminate the sharp periods of inflation and depression and would tend to keep business on a more even basis than at present.

# A STATISTICAL STUDY OF POOR RELIEF IN MASSACHUSETTS

By Katherine E. Howland, *Smith College*

Statistics relating to the nature and extent of poor relief have been compiled with far greater thoroughness in England than in America.[1] The central government of the United Kingdom gathers statistics of the number of paupers in institutions and also of the number in receipt of outdoor relief. Not only is there no central body of our federal government which collects statistics on poor relief, but in a large number of states not even figures are available for all the counties. In England and in Wales the total public expenditure for the support of the poor is also carefully ascertained annually, while in this country only a few of the states gather statistics relating to the amount expended from the public funds for the relief of the poor.[1] The field for historical investigation of poor relief in the United States is therefore limited to a few of the older states where records have been kept for a considerable period of years. It is the purpose of this study to discover if possible any tendencies relating to the nature and extent of poor relief in Massachusetts, where statistics relating thereto are available for a period of over fifty years, and incidentally to investigate the methods employed in recording the data bearing upon this subject.

Questions at once arise as to the percentage of the population of Massachusetts dependent upon public relief; the age, sex, and nationality of the recipients; the nature of the relief given; and the cost involved. Trends and analyses of the variability of these factors over a period of years may be expected to indicate significant aspects of the historical development of poor relief in Massachusetts. By attempting correlations of the percentage of the population in receipt of relief with such measures of business conditions as bank clearings or commercial failures, and average wages, we may still further investigate this problem of poverty.

The number per thousand of the population which received public relief during the years 1892 to 1920 is shown in Table I.[2] Vagrants, the insane, and the feebleminded are intended to be excluded from this enumeration, but owing to imperfect methods of classification and to differences in diagnosis this exclusion is incomplete. Previous to the formation of the State Board of Insanity in 1898 the care of the insane was one of the main functions of the State Board of Charity, and therefore no great need was felt for differentiating the insane from the poor.

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[1] Gillin, J. L., *Poverty and Dependency*, pp. 26–39. New York: The Century Co., 1921.

[2] Annual Reports of the State Board of Charity of Mass. 1875–1920. State Printers, Boston. This source was used throughout for all statistics of poor relief.

TABLE I

NUMBER OF POPULATION IN RECEIPT OF RELIEF CORRELATED WITH BUSINESS CONDITIONS

| Year | Total no. in receipt of relief in Mass. | Number per 1,000 in receipt of relief | Number of cases of vagrancy | Number in receipt of out-relief | Ratio of out-relief to total relief | Indexes of wages per week in 17 industries in the U. S. | Per cent per firms in business in the U. S. of commercial failures |
|---|---|---|---|---|---|---|---|
| I | II | III | IV | V | VI | VII[1] | VIII[2] |
| 1892 | 56,478 | 24.10 | 147,299 | ...... | ...... | 103.3 | 0.88 |
| 1893 | 54,819 | 22.88 | 141,481 | ...... | ...... | 102.2 | 1.28 |
| 1894 | 79,323 | 32.41 | 230,788 | ...... | ...... | 96.9 | 1.25 |
| 1895 | 82,544 | 33.01 | 304,244 | ...... | ...... | 97.8 | 1.09 |
| 1896 | 71,893 | 28.07 | 228,122 | ...... | ...... | 98.2 | 1.31 |
| 1897 | 78,122 | 29.79 | 241,230 | ...... | ...... | 98.2 | 1.26 |
| 1898 | 85,273 | 31.78 | 232,898 | ...... | ...... | 98.6 | 1.10 |
| 1899 | 85,591 | 32.28 | 207,326 | ...... | ...... | 101.3 | 0.81 |
| 1900 | 76,001 | 27.09 | 164,700 | ...... | ...... | 104.3 | 0.92 |
| 1901 | 75,913 | 26.68 | 170,986 | ...... | ...... | 107.2 | 0.90 |
| 1902 | 73,982 | 25.65 | 159,477 | ...... | ...... | 110.9 | 0.93 |
| 1903 | 72,094 | 24.65 | 129,997 | ...... | ...... | 115.5 | 0.94 |
| 1904 | 71,661 | 24.18 | 137,332 | ...... | ...... | 117.7 | 0.92 |
| 1905 | 81,413 | 27.10 | 117,513 | ...... | ...... | 120.3 | 0.85 |
| 1906 | 69,998 | 22.80 | 44,003 | ...... | ...... | 126.1 | 0.77 |
| 1907 | 64,310 | 20.50 | 26,224 | ...... | ...... | 130.7 | 0.82 |
| 1908 | 69,863 | 21.81 | 33,818 | ...... | ...... | 126.5 | 1.08 |
| 1909 | 78,923 | 24.13 | 32,798 | ...... | ...... | 125.8 | 0.80 |
| 1910 | 68,923 | 20.66 | 29,972 | ...... | ...... | 130.2 | 0.80 |
| 1911 | 71,441 | 20.97 | 32,300 | ...... | ...... | 132.3 | 0.81 |
| 1912 | 74,401 | 21.38 | 16,177 | 52,537 | 0.7061 | 135.7 | 0.98 |
| 1913 | 71,411 | 20.11 | 14,912 | 51,423 | 0.7061 | ..... | 0.99 |
| 1914 | 86,425 | 23.86 | 16,190 | 65,059 | 0.7528 | ..... | 1.10 |
| 1915 | 120,905 | 32.74 | 52,961 | 97,484 | 0.8063 | ..... | 1.32 |
| 1916 | 118,012 | 31.68 | 31,662 | 95,935 | 0.8129 | ..... | 0.99 |
| 1917 | 98,957 | 26.34 | 11,533 | 78,090 | 0.7892 | ..... | 0.80 |
| 1918 | 89,582 | 23.64 | 11,366 | 72,936 | 0.8142 | ..... | 0.58 |
| 1919 | 89,273 | 23.36 | 8,404 | 71,642 | 0.8025 | ..... | 0.38 |
| 1920 | 75,868 | 19.69 | 3,082 | 62,770 | 0.8274 | ..... | .... |

By Pearson's formula:

$r_{\text{III, VII}} = -0.833$ P.E. $= \pm 0.067$

$r_{\text{III, VIII}} = +0.426$ P.E. $= \pm 0.155$

Correlation after elimination of five-year moving average trend in each variable:

$r_{\text{III, VII}} = -0.622$ P.E. $= \pm 0.149$

$r_{\text{III, VIII}} = +0.438$ P.E. $= \pm 0.165$

[1] King, W. I., *The Wealth and Income of People of the United States.* London: The Macmillan Co., 1915. p. 203.

[2] Babson, R. W., *Half a Century of Business as Indicated by Babson's Business Barometers.* 1920.

Even had the attempt been made, knowledge of mental disease and defect has until recently been too meager to admit of a skilled diagnosis of insanity or of feeblemindedness. The exclusion of vagrants is almost equally difficult. Almshouses formerly served as winter quarters for many a tramp and as more temporary lodging houses for many more.[1]

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[1] Kelso, R. W., *The History of Public Poor Relief in Massachusetts*, p. 113. Boston: Houghton Mifflin Co. 1922.

Vagrancy formerly presented such a serious problem to the administrators of poor relief that it is a subject worthy of special consideration. The number of cases of vagrancy for the years 1890 to 1920 are shown in Table I, column IV. In 1895 the cases of vagrancy reached the high-water mark of 304, 244, which should be compared with the cases in 1920 numbering only 3,082. The virtual disappearance of this problem is even indicated by Poole's *Periodical Index.* In the volume for 1900–1904 references are given to over 30 articles on the tramp problem, while in the index for 1918 the only reference to tramps is, "See Walking Trips." The word "tramp" does not even appear in the 1919 index.

Vagrancy has waned before the steady growth of public opinion resulting in the gradual development of more scientific methods of relief and of prevention. Formerly the general attitude was, "Why should we pay the tramp's board bills in jail? Tell him to move on." This universal evasion of the problem is well illustrated in a report from the Associated Charities of Lawrence, Kansas, which states that "the custom here with vagrants is (1) arrest; (2) fine; (3) as they have no money, they are put to work on the rock pile; (4) no guard; (5) the vagrants run off; (6) which is what was planned."[1]

Column VI, in the first table, showing the ratio of the number in receipt of outdoor relief to the total number relieved, probably represents a growing tendency away from institutional care; but the lack of comparable figures for indoor and outdoor relief has so narrowed the limits of comparison that the results do not warrant the determination of a general trend. It is worth noting, however, that the state has adopted a definite policy of outdoor relief for dependent children which is known all over the world as the Massachusetts plan of child placement. The state now has 7,000 minor wards, and of these wards all children who are placeable are located in foster family homes.[2]

Possible correlation of the number in receipt of relief with some measure of business prosperity is suggested by a comparison of Wesley C. Mitchell's [3] interpretation of business cycles with the rise and fall in the amount of poor relief as shown in Table I. It appears that a period of business prosperity is shortly followed by a fall in the amount of poor relief, while a business depression such as occurred in the years 1893–94, 1896, 1903–4, 1907–8, and 1913 is soon followed by a rise in the curve showing the number per thousand inhabitants who receive relief. The following statement, by Dr. Mitchell, of business cycles merits a close comparison with Table I, column III.

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[1] *Atlantic Monthly,* vol. 101, pp. 744–53.

[2] Kelso, R. W., *op. cit.,* pp. 163, 186.

[3] *Business Cycles,* p. 88. University of California Press, Berkeley, 1913.

| | |
|---|---|
| 1892 | General business prosperous; heavy gold exports. |
| 1893 | Panic; acute in May to October. |
| 1894 | Deep depression. |
| 1895 | Revival in the summer; followed by relapse. |
| 1896 | Return of depression; panicky conditions in financial markets. |
| 1897 | First half dull; second half, great improvement on crop situation. |
| 1898 | Prosperity rising rapidly. |
| 1899 | High tide of prosperity in general business. |
| 1900 | Slight pause in activity, followed by outburst of speculation in the autumn. |
| 1901 | Prosperity in general business. |
| 1902 | Prosperity continued. |
| 1903 | Financial liquidation; "rich man's panic"; general business still active. |
| 1904 | Mild industrial depression. |
| 1905 | Rapid gain in prosperity. |
| 1906 | High tide of prosperity. |
| 1907 | Crisis and severe panic in October and December. |
| 1908 | Deep depression in trade and industry. |
| 1909 | Recuperation; marked in second half of the year. |
| 1910 | Return of depression in second half of the year. |
| 1911 | Mild depression. |

Of the correlations shown in Table I, that between the number in receipt of relief and index of wages in 17 principal industries in the United States computed by King (see explanation of source following the tabulation) shows the highest degree of association, there proving to be a negative correlation of 0.83 or, what is of greater significance, of 0.62 when the correlations are made of deviations around the trend lines. According to this association, variability in the number in the receipt of relief bears a distinct relation to the average wage paid. That is, there are a large number of persons who are not hopelessly and inherently paupers but who are dependent upon the marginal wage paid in industry. In times of prosperity these persons are independent. However, the wage which supports them is not only insecure, but it probably is also too meager to allow for saving against times of unemployment. The percentage of commercial failures appears to be less closely connected with the number of persons in receipt of relief, but the correlations found serve to substantiate the fact of a close connection between business prosperity and the extent of poor relief.

Let us now consider the age, sex, and nationality of the recipients of relief. Table II shows the age distribution of the recipients of relief for the year 1915 only. A close comparison, however, of the years from 1912 to 1920 reveals a lack of variability in the age distribution from year to year and shows that the mode of each year's distribution lies in the group from 5 to 9 years of age. Aside from any consideration of the age grouping of the general population, this fact is of great importance, showing as it does the need of a constructive program of poor relief with the emphasis placed upon child welfare. Causes for the rise in the percentage of the total number in receipt of relief occurring in the age groups from 20 to 34 might well be sought in a study of immigration and of the conditions in modern industry where the productive capacity of the worker reaches its maximum at an early age.

TABLE II

AGE DISTRIBUTION OF RECIPIENTS OF RELIEF AND OF THE GENERAL POPULATION

| Age | 1915 | | | | |
|---|---|---|---|---|---|
| | Number in receipt of relief | Per cent of total number in receipt of relief | General population | Per cent of general population | Per cent of general population in receipt of relief |
| 0– 5 | 13,524 | 11.19 | 363,297 | 9.84 | 3.72 |
| 5– 9 | 18,563 | 15.35 | 335,855 | 9.10 | 5.53 |
| 10–14 | 16,786 | 13.88 | 302,779 | 8.20 | 5.54 |
| 15–19 | 9,960 | 8.23 | 314,514 | 8.52 | 3.17 |
| 20–24 | 5,428 | 4.49 | 359,272 | 9.73 | 1.51 |
| 25–29 | 5,614 | 4.64 | 346,076 | 9.37 | 1.62 |
| 30–34 | 6,664 | 5.51 | 299,217 | 8.10 | 2.23 |
| 35–39 | 7,672 | 6.34 | 289,729 | 7.84 | 2.65 |
| 40–44 | 6,963 | 6.35 | 252,936 | 6.85 | 2.75 |
| 45–49 | 5,577 | 4.61 | 217,510 | 5.89 | 2.56 |
| 50–54 | 4,425 | 3.66 | 182,789 | 4.94 | 2.42 |
| 55–59 | 4,118 | 3.41 | 134,658 | 3.65 | 3.06 |
| 60–64 | 3,733 | 3.09 | 104,707 | 2.83 | 3.57 |
| 65–69 | 3,340 | 2.76 | 76,268 | 2.06 | 4.38 |
| 70–74 | 2,619 | 2.17 | 54,374 | 1.47 | 4.82 |
| 75–79 | 1,840 | 1.52 | 33,035 | 0.89 | 5.57 |
| 80–84 | 1,075 | 0.89 | 16,635 | 0.45 | 6.47 |
| 85–89 | 435 | 0.36 | 6,601 | 0.18 | 6.59 |
| 90–94 | 135 | 0.11 | 1,721 | 0.05 | 7.84 |
| 95–99 | 36 | 0.03 | 350 | 0.01 | 10.29 |
| 100– | 10 | 0.01 | 46 | 0.001 | 21.79 |
| Unknown | 2,388 | 1.98 | 941 | 0.03 | .... |
| Total | 120,905 | 100.00 | 3,693,310 | 100.000 | .... |

Comparison of the age distribution of the recipients of relief for the year 1915 with that of the total population for the same year shows not only that the greatest frequency is found in the age group from 5 to 9 years and that there is a marked increase again from 20 to 44, but also that these maximum frequencies are out of proportion to the distribution of the total population. What are the chances that at a given age an inhabitant of Massachusetts will be a recipient of public relief? This question is answered in part by the last column of Table II. Five and one-half per cent of the general population in the age groups of 5 to 10 receive relief, as compared with 1½ per cent of persons from 20 to 24, and 21 per cent of those over 100 years of age.

The distribution of the recipients of relief according to sex from 1912 to 1920 shows that of the total number in receipt of relief the proportion of females has risen from 50 to 54 per cent. It is impossible to determine what has been the change in the general population during that period. According to the state census of 1915, 51 per cent of the total population were females; but of the total number in receipt of relief during the same year, only 50.23 per cent were females.

The recipients of relief during the years 1912 to 1920 are classified according to country of birth in Table III. It will be noted that from 1912 to 1916 a higher percentage of the foreign-born were in receipt of relief than of the native-born, after which period the conditions are reversed. This change may well be the result of the stoppage of immigration during the world war. Immigration to the United States reached the high figure of 1,218,480 in the year 1914, while the following year it dropped to 326,700 and continued steadily to decrease until 1918, when the total gross immigration numbered only 110,618.[1]

Russian-Polish farmers are popularly supposed to exceed by far the native population in thrift and efficiency. For this reason it is surprising to note the relative position of the Russian-Polish in this table, especially when it is taken into consideration that immigration from these countries is so comparatively recent. There is, therefore, a much smaller proportion of this nationality in the upper age groups than of the native population. It might prove enlightening to supplement this data with a study of Polish and Russian occupations in Massachusetts.

Obviously, the general form of each distribution in Table III is accounted for by the increase in the receipt of relief throughout the entire population during the war. Statistics as to the nationality of the recipients of relief are not available for a consecutive period of years before the war and it is therefore impossible to determine the normal trend for the different nationalities. At the close of the war a marked tendency to cluster more closely around the average will be noted. It is interesting to observe that the smallest rates of poor relief are found among those nationalities most sparsely represented in the total population. Perhaps they represent a more selected group than those nationalities which are more numerous.

The cost of poor relief is shown in Table IV. Although the program of poor relief is far more elaborate than it was in 1878, contrary to popular opinion, the cost to each inhabitant has not noticeably increased. The real effect of the war upon the cost of poor relief is obscured by the war inflation of currency. When this inflation is only

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[1] Babson's Charts.

## TABLE III

## RECIPIENTS OF RELIEF CLASSIFIED BY COUNTRY OF BIRTH[1]

| Birthplace | Number per thousand given relief | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1912 | 1913 | 1914 | 1915 | 1916 | 1917 | 1918 | 1919 | 1920 |
| Native | 19.13 | 18.69 | 22.77 | 31.90 | 31.37 | 26.88 | 24.64 | 24.89 | 21.66 |
| Foreign | 22.39 | 20.78 | 24.79 | 31.37 | 33.73 | 26.60 | 23.41 | 22.59 | 18.07 |
| Canada | 22.53 | 22.43 | 24.33 | 32.98 | 31.03 | 17.23 | 22.69 | 17.00 | 16.01 |
| England | 23.15 | 22.24 | 24.91 | 31.93 | 29.83 | 24.28 | 19.94 | 17.45 | 13.62 |
| Germany | 13.24 | 13.97 | 14.08 | 19.00 | 18.15 | 14.84 | 11.71 | 11.64 | 8.33 |
| Ireland | 43.98 | 42.11 | 47.54 | 53.83 | 51.31 | 44.44 | 37.01 | 34.30 | 27.82 |
| Italy | 12.29 | 14.44 | 20.39 | 37.66 | 34.41 | 21.35 | 21.26 | 23.25 | 19.98 |
| Russia | 15.13 | 19.39 | 26.99 | 46.88 | 46.60 | 34.54 | 33.31 | 35.40 | 29.30 |
| Scandinavia | 8.91 | 8.51 | 9.69 | 13.38 | 13.12 | 9.43 | 11.25 | 10.62 | 7.82 |
| Scotland | 15.39 | 16.30 | 19.48 | 23.56 | 22.68 | 18.51 | 17.64 | 14.18 | 10.69 |
| All others | 15.22 | 8.90 | 12.79 | 23.70 | 24.36 | 28.07 | 16.78 | 20.92 | 13.51 |

[1] The distribution of the population by nationality could only be secured for the census year 1915, and as these figures were used in computing the percentage of the population according to nationality that received relief during the years 1912 to 1920, the results are subject to correction for every year except 1915.

roughly compensated for, as indicated in the table by the use of Babson's index of inflation, the rise in expenditure then appears similar to the increase in the amount of poor relief during the war, and of the same temporary character. It should, however, be noted, by comparison with Table I, column III, that the increase in cost during 1919 and 1920 is not accompanied by an increase in the receipt of poor relief.

TABLE IV

COST OF POOR RELIEF IN MASSACHUSETTS

| Year<br>I | Total net cost [1]<br>II | Cost per inhabitant<br>III | Consumer's index of inflation [2]<br>IV | Uninflated cost (consumer's)<br>V | Wholesaler's index of inflation [2]<br>VI | Uninflated cost (wholesaler's)<br>VII |
|---|---|---|---|---|---|---|
| 1878 | $1,098,642 | $0.787 | .... | .... | ... | .... |
| 1879 | 1,480,273 | 0.843 | .... | .... | ... | .... |
| 1880 | 1,412,388 | 0.793 | .... | .... | ... | .... |
| 1881 | 1,370,000 | 0.718 | .... | .... | ... | .... |
| 1882 | 1,426,702 | 0.772 | .... | .... | ... | .... |
| 1883 | 1,496,032 | 0.797 | .... | .... | ... | .... |
| 1884 | 1,542,824 | 0.808 | .... | .... | ... | .... |
| 1885 | 1,700,520 | 0.875 | .... | .... | ... | .... |
| 1886 | 1,720,795 | 0.891 | .... | .... | ... | .... |
| 1887 | 1,751,888 | 0.844 | .... | .... | ... | .... |
| 1888 | 1,826,872 | 0.849 | .... | .... | ... | .... |
| 1889 | 1,811,805 | 0.822 | .... | .... | ... | .... |
| 1890 | 1,878,710 | 0.839 | .... | .... | ... | .... |
| 1891 | 1,808,162 | 0.777 | .... | .... | ... | .... |
| 1892 | 1,869,244 | 0.789 | .... | .... | ... | ..... |
| 1893 | 1,903,534 | 0.790 | .... | .... | ... | .... |
| 1894 | 1,993,263 | 0.814 | .... | .... | ... | .... |
| 1895 | 2,154,573 | 0.892 | .... | .... | ... | .... |
| 1896 | 2,190,515 | 0.858 | .... | .... | ... | .... |
| 1897 | 2,272,488 | .867 | .... | .... | ... | .... |
| 1898 | 2,372,661 | 0.887 | .... | .... | ... | .... |
| 1899 | 2,522,410 | 0.919 | .... | .... | ... | .... |
| 1900 | 2,492,060 | 0.902 | .... | .... | ... | .... |
| 1901 | 2,551,074 | 0.898 | .... | .... | ... | .... |
| 1902 | 2,694,891 | 0.933 | .... | .... | ... | .... |
| 1903 | 2,780,751 | 0.952 | .... | .... | ... | .... |
| 1904 | 2,957,909 | 0.999 | .... | .... | ... | .... |
| 1905 | 3,096,035 | 1.033 | .... | .... | ... | .... |
| 1906 | 3,460,633 | 1.127 | .... | .... | ... | .... |
| 1907 | 3,240,763 | 1.034 | .... | .... | ... | .... |
| 1908 | 3,409,418 | 1.064 | .... | .... | ... | .... |
| 1909 | 3,712,689 | 1.135 | .... | .... | ... | .... |
| 1910 | 3,486,292 | 1.045 | .... | .... | ... | .... |
| 1911 | ....... | .... | .... | .... | ... | .... |
| 1912 | 3,345,776 | 0.961 | .... | .... | ... | .... |
| 1913 | 2,846,085 | 0.801 | .... | .... | ... | ... |
| 1914 | 3,118,497 | 0.861 | 100 | $0.861 | 100 | $0.861 |
| 1915 | 4,047,471 | 1.096 | 100.5 | 1.090 | 101 | 1.085 |
| 1916 | 4,586,091 | 1.231 | 108.7 | 1.132 | 120 | 1.026 |
| 1917 | 4,663,940 | 1.241 | 131.7 | 0.942 | 187 | 0.664 |
| 1918 | 5,165,067 | 1.363 | 152.2 | 0.895 | 193 | 0.706 |
| 1919 | 5,846,121 | 1.504 | 172.2 | 0.873 | 219 | 0.687 |
| 1920 | 7,684,160 | 1.994 | 191.4 | 1.042 | 230 | 0.871 |

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[1] Total net cost does not include cost of upkeep. Owing to the frequent obscurity in the distinction between state expenses and those of cities and towns, part of which are reimbursed by the state, the figures in this column are in the nature of a close estimate. For the year 1911, the state expenses are not given. By way of explanation it is stated in the annual report that "for the present report, comparable data of state care are not available."

[2] Babson's Reports.

Even this brief study reveals complexities in the analysis of poor relief. General business conditions, as measured roughly by bank clearings or commercial failures, and more especially by index of wages, affect the problem to an extent most difficult to determine. Age, sex, and nationality involve still other causes of variability and present other differences which should modify any program of relief. Study of poor relief from the standpoint of expenditure is complicated by the difficulty of securing a suitable index of depreciation of currency. Furthermore, questions as to the nature and effect of the relief given should not be considered apart from the growth and changes in public opinion, viewed as a main factor affecting the attitude of the recipients of relief as well as directing the public policy.

Accurate and complete records are essential to scientific study of such a problem as poor relief. Frequent changes in the method of securing and of recording data in the state reports at present make much valuable material incomparable. Some such plan as the following would render possible an increase in scientific knowledge which would be valuable in the administration of poor relief. The scheme should be drawn up by a federal board and adopted by every state that each may profit by the experiences of the others:[1]

I. Schemes for tabulation should be drawn up by a committee of expert statisticians to be followed under penalty of law for five years at least.

II. These schemes should cover all tabulations made by the towns and cities which enter into the state report, as well as those of the state, and also the method of final presentation of the combined material in the Annual State Reports.

III. At the close of the period prescribed by law, as recommended in I, the committee should incorporate useful suggestions into the scheme of tabulation to be followed during the next period. These changes should be clearly explained to all persons engaged in the compilation of statistics that are in the state report, as well as in the annual report itself, and the nature of the changes should be so stated that the data in any two consecutive periods may be rendered easily comparable.

IV. Special standard requirements needing greater emphasis than hitherto are as follows: (a) Outdoor relief should be carefully distinguished from indoor relief. (b) An analysis of new cases should be included as distinguished from the total number of cases. (c) A similar analysis of discharged cases should be made. (d) Classification of costs should be so standardized that the following totals for both the state and for the cities and towns are independent and exhaustive: (1)

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[1] Such a scheme is of course impossible under the present legal organization of the United States.

Cost of persons relieved, not including expense of administration and upkeep. (2) Cost of administration and upkeep, the nature of all "incidental" expenses to be clearly specified. (3) Aggregate cost to the state, making due allowances for reimbursements, etc.

V. Summaries of the preceding years should include: (a) A brief comparison with the year directly preceding. (b) A more exhaustive review every 10 years. (c) An exhaustive statistical study every 25 years.

# NOTES

## THE EMPLOYMENT STATISTICS OF THE UNITED STATES EMPLOYMENT SERVICE

By Ralph G. Hurlin, *Russell Sage Foundation*

At the beginning of the year 1921 the United States Employment Service commenced the collection and publication of a monthly series of employment statistics as an adjunct to its other employment services. These statistics covered all important manufacturing industries and were obtained from a fixed number of firms in 65 large cities distributed throughout the United States. The data were published both in detail by cities and industry groups and in aggregate, the latter figures being interpreted as an index of employment fluctuation in manufacturing industries for the United States as a whole.

The scope and apparent nature of these figures were such as to raise hope that they would fill the need of such a representative index. The figures were made available shortly after their collection each month and they were much used during the depression period as indicating the course of industrial conditions. Criticism of the figures appeared, however, and in June, 1922, following the appearance of the report for May, their publication was discontinued by the Secretary of Labor with the explanation that this function was one to be reserved to the Bureau of Labor Statistics, a companion bureau in the Department of Labor.[1] In this case the question of whether or not statistics should be collected by the bureau requiring them in the exercise of its other functions or by another, primarily statistical, bureau, is clearly a matter of departmental administration and need not be raised here. The purpose of this article is rather to appraise the results of what has constituted a very extensive experiment in the collection of employment statistics.

In planning for the Employment Service statistics, economy of time in obtaining the data was considered an essential requirement, and in some degree this consideration determined the nature of the figures obtained. This and some other characteristics of the data make it of interest to see to what extent the figures appear to be a valid index of employment during the period for which they are available.

### CHARACTER OF THE DATA

The index afforded by these figures is a large-city index, no data having been collected from establishments in rural communities or in small cities. It is also a large-establishment index. With one or two exceptions, only establishments employing under good conditions of business over 500 hands were included, and many of those included were excessively large establishments. Thus the total number of employees represented fluctuated around 1,500,000, which is 17 per cent of the total number of wage earners in manufacturing industries according to the census of manufactures for 1919, while the number of establishments was 1,428, or only half of one per cent of the total number of establishments enumerated in the census of 1919.

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[1] Industrial Employment Information Bulletin, June, 1922.

The figures themselves are described as pay-roll figures. They were obtained, in the largest district (including New York, New Jersey, and Pennsylvania) at least, upon printed schedules, bearing the single question of how many hands were employed on a specified date. These schedules were mailed to each establishment. Paid agents were placed in charge of the collection of the data in each of nine districts, but the information was actually obtained from the establishments in the several cities by unpaid agents, who secured the returns from the establishments and forwarded them to the district agents. The data were tabulated in the offices of the district agents, by cities and by industries, and in this form were telegraphed to the Washington office of the Service.

It is on the point of collection of the data that much criticism has been raised. Objection has been made to the fact that the collecting agents were not statistically trained and that in some districts due care was not exercised in securing authentic pay-roll figures. It is apparently true that there was variation from city to city in the precise method of collecting the figures, and in the case of at least one city the published figures themselves suggest careless or inaccurate returns. But this by no means characterizes the figures as a whole, and they furnish strong internal evidence of essential reliability.

### COMPARISON WITH OTHER INDEXES

Examination of the statistics both by comparison with other indexes and by comparison of the trends recorded for the same industries in different cities suggests that the means of collection was for the most part sufficiently sound to give dependable results, and that the large-city, large-establishment index is representative. In the upper section of Diagram 1 the aggregate figures of the Employment Service are compared with those of the New York Industrial Commission for employment in New York State, for the 17 months from January, 1921, through May, 1922. The New York index is to less extent a large-establishment index, and it represents the entire state including the small cities and other manufacturing communities. Because of the industrial composition of the state, this index has been regarded as a good indication of the course of employment in the United States as a whole. It is clear that the two curves reflect the same general tendencies.[1]

The lower section of the diagram presents the adjusted index of the Harvard Bureau of Economic Research for production in manufacturing industries in the United States. Because this curve has been "corrected" to show only cyclical fluctuation by eliminating other variations, it is not strictly comparable with the "uncorrected" curves above it. It is presented to show that it records the same turning point in the cycle, July, 1921, as does the Employment Service's employment index.

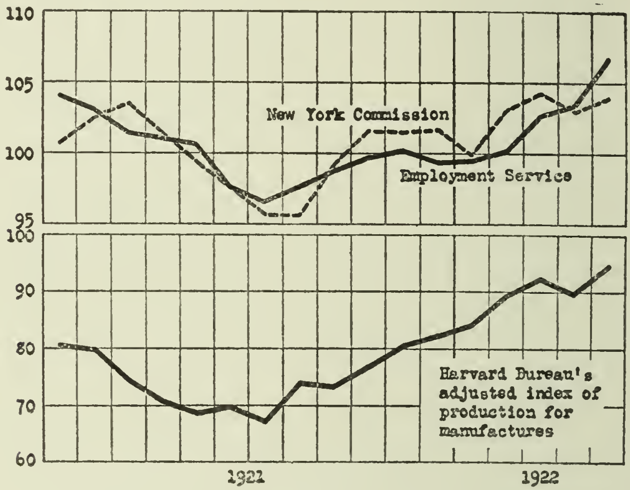

Diagram 1. Employment Indexes of the United States Employment Service and the New York Industrial Commission, and Adjusted Production Index of the Harvard Bureau of Economic Research, January, 1921, to May, 1922

INDEXES FOR INDUSTRIAL AND GEOGRAPHICAL GROUPS

In order to test further the validity of the index, the figures have been broken up in each of the industrial groups into small geographical units. The industrial groups for which the figures are published are the 14 groups used by the Census Bureau in the census of manufactures. For the present purpose the 65 cities were divided into eight geographically related groups, and curves were drawn for each industry in each of these geographical divisions. Conspicuous similarity was found between the curves for the same industrial groups with certain exceptions. Most of the exceptions were cases in which the curves represented too few employees to constitute a fair sample for the industry. In many cases such curves represented a single establishment or but two or three establishments in a given city. Other exceptions were cases which could be explained either by local industrial conditions, as in the case of the decline in the textile curve for New England due to the textile strike in that section in early 1922, or by the lack of homogeneity in the industrial group itself.

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[1] The December figure plotted in the Employment Service curve is not the published figure. The published figure was evidently too low, for a reason which is explained below. The figure here used represents the change registered in December by the aggregate figures minus those for the vehicle industry in the single city, Detroit.

A portion of the composite chart of the curves for each of the 14 industries in each of the geographical divisions is shown in Diagram 2. It presents the curves for "all industries" and for three of the largest industrial groups, "iron and steel and their products," "textiles and their products," and "vehicles for land transportation." The first column of small diagrams is that for all industries. It shows striking differences in the curves for the several geographical divisions. These differences are clearly due to the influence of different industries. In Pennsylvania and Ohio the influence of iron and steel predominates. In New England the effect of iron and steel is balanced by that of textiles. In the North East Central division the vehicle group is sufficiently large to determine the character of the total curve.

The general form of the total iron and steel curve, shown at the bottom of the second column of diagrams, is seen in the iron and steel curve for each geographical division except that for the Pacific states. Here the figures are for few establishments and, in one case, for an establishment apparently undergoing rapid growth. This establishment would have had no effect upon the iron and steel curve for Pennsylvania and Ohio, but it has a controlling influence in the small sample for this industry in the Pacific states.

The textile industry shows similar striking agreement except in the case of the Pacific states, where again the sample is small. In this case the figures for one city, which account for the marked distortion of the curve in August, September, and October, 1921, are given throughout in round numbers, which fact suggests the possibility of inaccurate returns.[1]

The curves for vehicle industries illustrate lack of agreement because

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[1] The published figures for the textile group in Los Angeles are: 510, 500, 500, 500, 525, 525, 525, 1,000, 1,000, 1,000, 425, 300, 350, 350, 350, 350, 455.

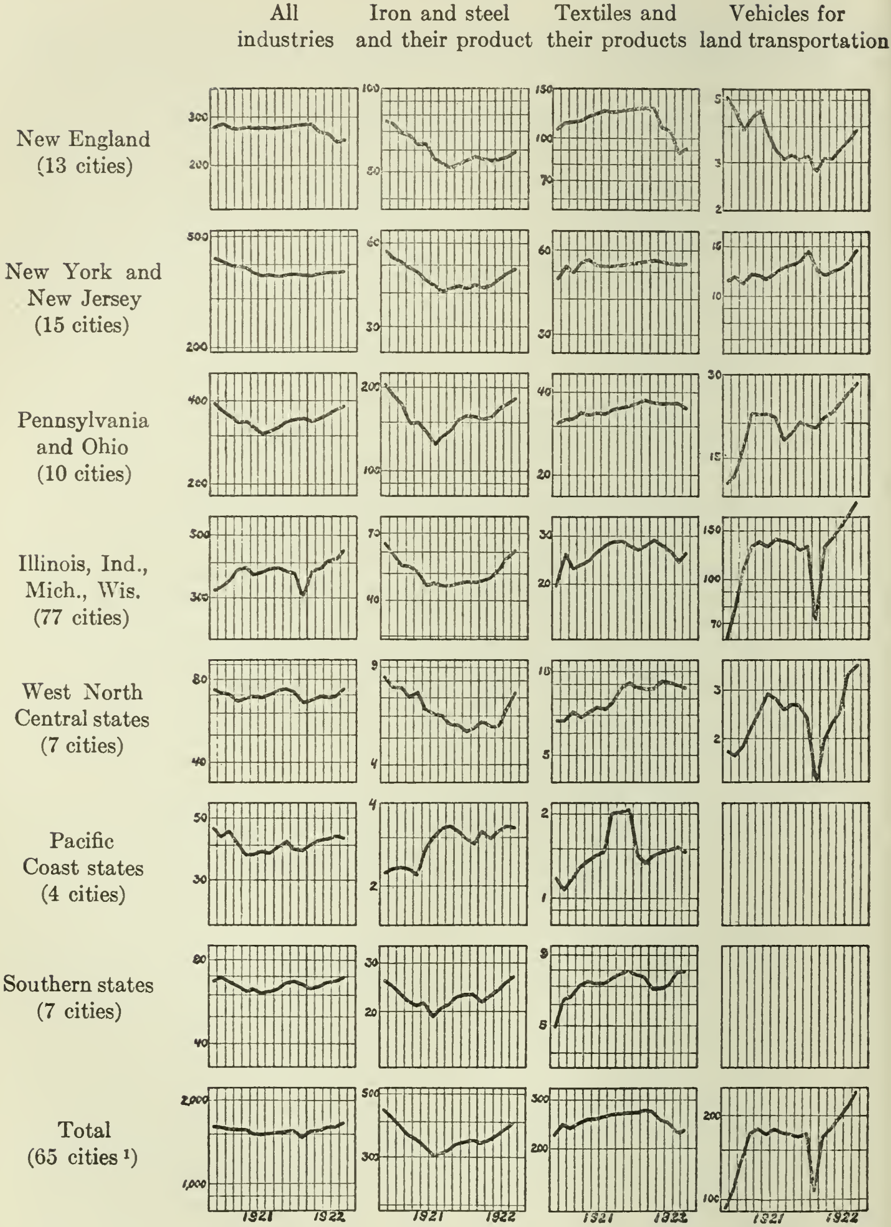

Diagram 2. Employment Indexes Obtained from United States Employment Service Data

Scale figures represent thousands of employees. Ratio backgrounds are used to permit direct comparisons between all curves

[1] Including two cities, Denver and Baltimore, not included in the sectional groups.

of difference in the composition of the group. The form of the total curve for vehicles is seen in the vehicle curves for the Pennsylvania and Ohio, North West Central, and North East Central groups, but the vehicle curves for New York and New Jersey and for New England are of different character. In the former case it is evident that the group represents primarily automobile manufacture, while in New York and New Jersey, and particularly in New England, it is probable that other vehicle industries are represented. No establishments in this group are included in the Southern or Pacific Coast cities.

So far as this form of analysis goes, it suggests that the figures obtained offer good indexes for the several industrial groups when these groups are similarly composed in the respective cities.[1] Other industrial groups within which good agreement is shown are: miscellaneous industries, which group probably here, as in the case of the census group itself, contains a large element of electrical machinery; leather; lumber; and paper and printing. In the food, chemicals, and stone-clay-and-glass groups varying employment trends are represented by component industries in each case. It is probable that for the purposes of an employment index changes in the census classification in the case of certain groups could profitably be made.

PERCENTAGE DISTRIBUTION OF WAGE-EARNERS IN EMPLOYMENT SERVICE INDEX AND IN ALL MANUFACTURES

| | Employment Service index (average 12 months, 1921) | Census of Manufactures (average 12 months, 1919) | Difference |
|---|---|---|---|
| Textiles and their products | 16.4 | 17.7 | −1.3 |
| Iron and steel and their products | 22.5 | 17.4 | 5.1 |
| Lumber and its manufacture | 1.5 | 9.2 | −7.7 |
| Food and kindred products | 8.4 | 7.5 | .9 |
| Railroad repair shops | 3.9 | 5.7 | −1.8 |
| Paper and printing | 3.2 | 5.6 | −2.4 |
| Vehicles for land transportation | 9.9 | 5.5 | 4.4 |
| Chemicals and allied products | 4.8 | 4.7 | .1 |
| Leather and its finished products | 3.2 | 3.9 | − .7 |
| Metals and metal products other than iron and steel | 4.9 | 3.7 | 1.2 |
| Stone, clay, and glass products | .9 | 3.3 | −2.4 |
| Tobacco manufactures | 1.9 | 1.7 | .2 |
| Liquors and beverages | .1 | .6 | − .5 |
| Miscellaneous industries | 18.4 | 13.5 | 4.9 |
| Total | 100.0 | 100.0 | ..... |

A fault of the index which appears to be of greater importance than the character of the figures themselves or the manner of their collection is the matter of industrial weighting. The accompanying table compares the industry weights in the employment index with the distribution of wage-earners shown in the census of manufactures for 1919. Iron and steel is excessively represented, as is the miscellaneous group, which resembles iron and steel to some extent. The vehicle group also has too great weight, whereas lumber is seriously underweighted. In view of the difficulty of controlling weights in a fixed-establishment index the differences shown in the table are not entirely surprising, however.

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[1] It should also be said that similar agreement is shown between these and other employment statistics for the same industrial groups, where similar classification of industries has been used.

### EFFECT OF THE FORD PLANT

It is much less certain that even approximately accurate weights are represented in the aggregate figures for individual cities. Here the disturbing effect of the excessively large establishments becomes evident. This may be illustrated by referring again to Diagram 2. In the case of vehicles in the North East Central section the curve represents about 130,000 employees, most of them contributed by one city, Detroit. A sharp drop is recorded in the vehicle figure for Detroit in December, 1921, which causes the deep depression in the vehicle curve for the section. It is probable that this was not an actual drop in employment but rather an interruption for inventory at the end of the year, since the loss was made up in the January figure. The amount of the drop for vehicles in Detroit was a little less than the number of employees in the Detroit Ford plant, and as practically all departments of this plant were closed for inventory at the end of December and as employment in other vehicle plants in Detroit is not sufficient to account for the drop, it appears that this establishment is accorded influence in the index sufficiently large to control the total curve for the North East Central section and that for the entire vehicle industry. It also accounts for the drop in this month in the aggregate curve for all industries in all cities, which causes the aggregate index to register its lowest point in December, rather than at the turning point of the depression in July. By eliminating the figures for vehicles in Detroit alone, a more representative figure for December is obtained. This was used in the construction of the curve in Diagram 1.

### CONCLUSIONS

This analysis of the Employment Service figures is not assumed to be exhaustive. Nevertheless the following conclusions concerning these figures and concerning the larger problem of a representative index for manufacturing industries seem to be justified:

1. It is feasible to collect data for a representative employment index from a large number of cities in a short space of time and to make the figures available within a few days of the date of their collection.

2. The use of non-statistically trained agents is not necessarily a reflection upon the character of the figures.
3. A large-establishment and large-city index, if properly weighted industrially and geographically, is representative of employment trends for the country as a whole.
4. The geographical influence in the case of employment fluctuation is of slight importance compared with the industrial influence.
5. Although large establishments may be considered representative, care should be taken in the composition of an index to avoid excessively large establishments in cases where they alone control the index as a whole, or significant portions of it.

These statistics are no longer published in the bulletin of the Employment Service, but the machinery for their collection is still in operation in 65 cities and the figures are being returned each month for the use of the Employment Service. For the sake of completion of the record of an important period of employment fluctuation it is to be hoped that they may in time be made available to persons outside the Bureau. With minor changes in the list of establishments returning the figures and with only slight supervision of their collection, it appears probable that these statistics might be made to furnish a thoroughly reliable index of employment fluctuation for the country as a whole, and also reliable indexes both for particular industries and for individual cities. The latter service, which is of increasing importance, is one that is not now afforded by any other series of employment statistics.

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## THE DETERMINATION OF SECULAR TREND RECONSIDERED

By Holbrook Working, *University of Minnesota*

Statisticians will note with pleasure Professor W. L. Crum's discussion of the determination of secular trend in the issue of this Journal for June, 1922. It is one of the welcome signs of the growing interest of mathematicians in the problems with which scientists are struggling in the application of statistical methods in their various fields. The increasing use of statistical methods which economics is experiencing is common to many sciences. In all these sciences progressive workers are finding present knowledge of methods sadly inadequate. The necessity of devoting a large portion of their time to the acquirement of the requisite mathematical knowledge and the development of new and more adequate statistical methods has placed on such workers a heavy burden which is seriously retarding the progress of their work. The prospect of aid from properly trained mathematicians is cause for rejoicing.

Professor Crum's discussion exhibits a weakness, however, to which the mathematician is naturally prone, and which seriously diminishes the value of his work from the point of view of the statistician. Proposing a method of calculating secular trend which is considerably more laborious than the present method, he neglects to prove that it introduces substantial advantages.

Professor Crum's point, it will be remembered, is that for many purposes the line of secular trend of a time series should be fitted by a method which gives the sum of the squares of the percentage deviations therefrom a minimum. The usual method, of course, gives the sum of the squares of the actual deviations a minimum. The validity of this point is unquestionable, and Professor Crum has made a distinct contribution in providing a method for obtaining the desired fit.

Unfortunately, for the practical statistician, Professor Crum has not gone on to present adequate evidence of the usefulness of his method. Approximations are always acceptable, even in theoretical mathematics, provided they are of a sufficient degree of closeness. It is the opinion of the present writer that the usual method of determining secular trend is such an adequate approximation. In support of this contention the following observations are submitted. It is hoped that they may lead Professor Crum or some other mathematician to provide a more adequate treatment of the subject as it concerns the practical statistician, to whom the labor of extended computations is a large consideration.

The method of *ratios*, to adopt Professor Crum's terminology, is claimed to give a line of secular trend which may differ notably from that obtained by the method of deviations, either in vertical position ($a$) or in slope ($m$) or in both.

The question may be attacked most simply by assuming a line fitted by the usual method, that of deviations, and considering the deviations —the $d$'s—and the ratios—the $\frac{d}{x'}$'s—($x'$ being taken as the ordinate of secular trend corresponding to the deviation $d$). Consider first the values obtained for $a$. By definition we have $\Sigma d = 0$. The value of $a$ for the line of secular trend fitted by the method of ratios will differ from that obtained by the method of deviations only in case $\Sigma \frac{d}{x'} = 0$. If the line of secular trend be horizontal, each value of $d$ is divided by the same value of $x'$ and it follows of necessity that if $\Sigma d = 0$, $\Sigma \frac{d}{x} \neq 0$. Hence, in this case $a$ is the same for both methods.

If the line of secular trend be inclined from the horizontal, it is possible that the positive values of $d$ might in general be associated with somewhat smaller values of $x'$ than the negative values of $d$. In such a case we would have $\Sigma\frac{d}{x'}>0$, indicating that $a$ would be larger if obtained by the method of ratios than if obtained by the method of deviations. Similar reasoning shows the possibility of having $\Sigma\frac{d}{x'x'}<0$ due to the positive values of $d$ being associated in general with larger values of $x'$ than the negative values of $d$.

In the absence of rigorous mathematical demonstration the above situations may be accepted as actual possibilities on the basis of the evidence submitted by Professor Crum. However, it is difficult to see how $\Sigma\frac{d}{x'}$ could be greater or less than zero by any considerable amount if the trend is approximately linear. Professor Crum cites three examples in which the values obtained are as follows:

| Method | Value of $a$ | | |
|---|---|---|---|
| Method of deviations | 2.9 | 9.9 | 398 |
| Method of ratios | 3.1 | 10.0 | 440 |

There is obviously either a miscalculation or a misprint in the third case as a value of 440 is impossible. The difference in the second case is not clearly significant, since a difference of one unit in the last place may be due to a difference of but one or two units in the succeeding place. The difference in the first case, assuming the computations to have been carried to a sufficient number of places, is significant, subject to two qualifications: (1) it may possibly be due to the fact that the method of ratios introduces an approximation;[1] (2) the series for which the values are computed is too short (seven observations) to be surely typical.

The writer has calculated the value of $\Sigma\frac{d}{x'}$ for seven series for which the data happen to be readily available. The series tested are the values of the annual production of hay, corn, oats, and wheat for 35 years, 1879–1913, as given by Professor Day (the first four of a group of twelve series published in one place,[2] and three series contained in unpublished material calculated by the present writer. In all but one of the seven cases $\Sigma\frac{\mathrm{d}}{x'}=0$, within the limits of accuracy fixed by the number of places carried in the computations. The exception occurs in the case of oats, where $\Sigma\frac{d}{x'} = -.056$, and $\dfrac{\Sigma\frac{d}{x'}}{N} = -.0016$. The latter is the more significant figure, as it is a measure of the vertical displacement of the line of secular trend. The values obtained for $\dfrac{\Sigma\frac{d}{x'}}{N}$ for the seven series are as follows:

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[1] *Cf.*, Jour. of the Amer. Stat. Ass'n, June, 1922, p. 213.

[2] *Cf. Rev. of Economic Statis.*, September, 1920, p. 258.

| Series | Years included | $\dfrac{\Sigma\frac{d}{x'}}{N}$ |
|---|---|---|
| 1 (Hay) | 35 | −0.0008 |
| 2 (Corn) | 35 | +0.0002 |
| 3 (Oats) | 35 | −0.0016 |
| 4 (Wheat) | 35 | +0.0004 |
| 5 | 23 | −0.0001 |
| 6 | 22 | +0.0002 |
| 7 | 20 | +0.0002 |

In the case of oats, where the discrepancy is appreciable, the fit given by a straight line is not good; and an error of −0.0016 in its vertical position is insignificant.

The evidence from trial of specific cases, therefore, is distinctly in favor of the assumption that where the secular trend of a series is approximately linear, we shall have $\Sigma\frac{d}{x'} = 0$ (very nearly), and hence that the method of deviations will prove satisfactory in determining the vertical position of the line of secular trend.

Consider now the question of the slope of the line of secular trend. The method of deviations gives $\Sigma d^2$ a minimum. The method of ratios should give different results only when a different line would give $\Sigma\left(\frac{d}{x'}\right)^2$ a minimum. Under what conditions will $\Sigma d^2$ be a minimum, but $\Sigma\left(\frac{d}{x'}\right)^2$ be not a minimum?

The answer may be obtained from a consideration of Figure 1. The central group of points are those used by Professor Crum in his second example. The large black circles are at a distance from $AB$ proportioned according to $d^2$ for the corresponding values of $x$. The large hollow circles are at a distance from $AB$ proportioned according to $\left(\frac{d}{x'}\right)^2$ for the corresponding values of $x$. Adopting the concept of the method of moments, these large circles may be looked upon as exerting a pull upon $AB$ in proportion to their distance therefrom. If the solid circles be considered, these pulls are in equilibrium ($\Sigma d^2$ is a minimum). But if the large hollow circles be considered, these pulls are not in equilibrium. The forces exerted about the lower end of the line have been increased (as compared with the solid circles), the forces about the upper end of the line have been decreased. It chances that the forces about the ends of the line are predominantly upward, so there is now a tendency to swing this line about its center. This is the explanation of the different slope obtained by the method of ratios.

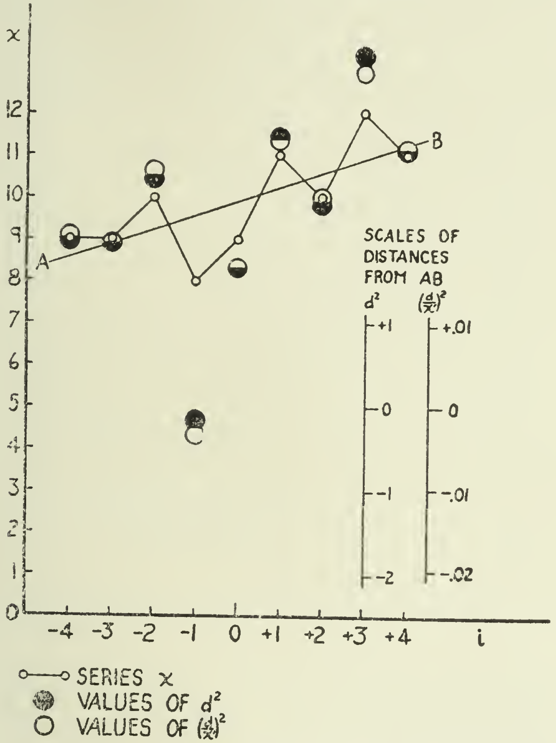

FIGURE 1. *AB* being placed to give the best fit for actual deviations, it will not in this case give the best fit for percentage deviations.

Under what conditions will the forces at the ends of the line of secular trend be predominantly in one direction? Only when the trend is not linear. The curved line in Figure 2 is a parabola fitted by the method of least squares to the series shown in Figure 1. Clearly, the trend of the series is far from linear. Only the shortness of the series prevented this curvature from being immediately obvious. Were the trend of the series truly linear, $\Sigma\left(\frac{d}{x'}\right)^2$ would be a minimum also, and the method of ratios would give the same slope to the line of secular trend as that obtained by the method of deviations.

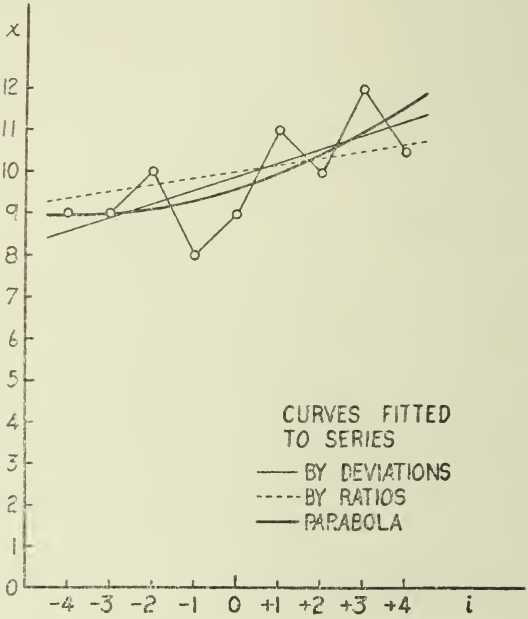

Figure 2. The curvature of the parabola shows that the trend of the series is not linear. This is the cause of the difference in slope of the two straight lines fitted to the series.

After a careful consideration of the principles involved, and a test in several specific cases, the following conclusion appears justified:

A straight line fitted by the method of least squares to a time series having an approximately linear trend gives a fit which is almost equally satisfactory whether actual deviations be considered or percentage deviations from the corresponding ordinates of secular trend. Professor Crum's criticism of the usual method is theoretically valid, but of little practical significance.

# INDUSTRIAL CLASSES IN THE UNITED STATES IN 1920

By Alvin H. Hansen, *University of Minnesota*

In an article on "Industrial Class Alignments in the United States" published in the issue of this Journal for December, 1920, the writer made a study of the census occupational statistics for the years 1870–1910 for the purpose of classifying the gainfully employed into industrial classes. The purpose of this paper is to bring that study up to date.

The 1920 census material on occupational statistics differs somewhat in its classifications from the 1910 census. These differences, however, cause no significant difficulties so far as the present study is concerned. With a few unimportant exceptions the classifications described in the earlier study were followed, the only exception of any consequence being the transfer of chauffeurs from the "lower salaried" group to the "industrial wage-earning" class. This change seemed to be desirable because many persons formerly listed as "deliverymen" were classified in the 1920 census as "chauffeurs."[1] It is quite clear that the vast majority of persons returned as "chauffeurs" in 1920 were engaged in some form of industrial work.

The number of gainfully employed persons falling into each of the classifications described in the earlier study for each of the ten year periods from 1870–1920 is given in Table I. The percentage distribution is given in Table II.

A number of significant changes for the year 1920 will be noted. The number of farm laborers has enormously decreased, both absolutely and relatively. This is explained in the 1920 census bulletin on occupational statistics as follows:[2] First, the change in the census date from April 15 to January 1 tended to reduce the number of agricultural laborers for two reasons: (1) fewer laborers were employed in agriculture at that season and hence many laborers who would have been employed as farm laborers in April were returned in January under some other occupation; (2) children living on the home farm were in many cases not returned as either gainfully employed or attending school, whereas had the census data been for April instead of January they would doubtless have been returned as gainfully employed. In the second place, the war resulted in a considerable transfer of labor from the farms to the factories. For these reasons it can scarcely be doubted that the figure for agricultural laborers for 1920 is an under-

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[1] Comparative Occupation Statistics, Fourteenth Census Bulletin, p. 3.

[2] Comparative Occupation Statistics, Census Bulletin, pp. 2–3.

TABLE I

| | 1870 | 1880 | 1890 | 1900 | 1910 | 1920 |
|---|---|---|---|---|---|---|
| Farm laborers | 2,885,996 | 3,323,876 | 3,004,061 | 4,410,877 | 6,143,998 | 4,178,637 |
| Farmers | 3,000,229 | 4,282,074 | 5,370,181 | 5,770,738 | 6,229,161 | 6,463,708 |
| Proprietors and officials | 581,378 | 807,049 | 1,347,329 | 1,811,715 | 2,879,023 | 3,168,418 |
| Professional | 414,708 | 666,338 | 1,114,507 | 1,565,686 | 2,074,792 | 2,760,190 |
| Lower salaried | 309,413 | 529,473 | 965,852 | 1,329,928 | 2,393,620 | 3,985,306 |
| Servants | 975,734 | 1,075,655 | 1,454,791 | 1,453,677 | 1,572,225 | 1,270,946 |
| Industrial wage-earners | 3,328,351 | 5,286,829 | 7,360,442 | 10,263,569 | 14,556,979 | 17,648,072 |
| Unclassified | 1,010,114 | 1,420,795 | 2,118,498 | 2,467,043 | 2,317,538 | 2,138,971 |
| Total | 12,505,923 | 17,392,099 | 22,735,661 | 29,073,233 | 38,167,336 | 41,614,248 |

TABLE II

| | 1870 | 1880 | 1890 | 1900 | 1910 | 1920 |
|---|---|---|---|---|---|---|
| Farm laborers | 23.1 | 19.1 | 13.2 | 15.2 | 16.1 | 10.0 |
| Farmers | 24.0 | 24.6 | 23.6 | 19.8 | 16.3 | 15.5 |
| Proprietors and officials | 4.6 | 4.6 | 5.9 | 6.2 | 7.5 | 7.6 |
| Professional | 3.3 | 3.8 | 4.9 | 5.4 | 5.4 | 6.6 |
| Lower salaried | 2.5 | 3.0 | 4.3 | 4.6 | 6.3 | 9.6 |
| Servants | 7.8 | 6.2 | 6.4 | 5.0 | 4.1 | 3.1 |
| Industrial wage-earners | 26.6 | 30.4 | 32.4 | 35.3 | 38.2 | 42.4 |
| Unclassified | 8.1 | 8.2 | 9.3 | 8.5 | 6.0 | 5.1 |

statement. On the other hand the 1910 figure for farm laborers is an overstatement compared to the figures given in the earlier census reports.[1] At all events it appears clear that the proportion of farm laborers to the total gainfully employed is not increasing and is probably no greater now than it was in 1890. This is striking, in view of the disappearance of free land and the increasing expense of setting up as independent farmers. The explanation no doubt lies in the increasing industrialization of the country with the consequent drain of labor to the cities.

Other significant changes appear in 1920. There was a considerable *absolute* decrease in the servant class and a very great *relative* decrease. This is in line with a steady decline since 1870. The servant class was two and a half times as important in proportion to other classes in 1870 as in 1920. This decrease is however more apparent than real. Personal service work has increasingly become industrialized. A large part of the work which was done in the home in 1870 was done outside of the home in 1920. Much house work has passed from the handicraft stage to the factory stage. The preparation of food is a case in point. Moreover, specialized occupations in the personal service field have been added from time to time with each succeeding census. For example, the 1920 census lists charwomen and cleaners, cleaners and renovators, porters, and elevator tenders in the personal service group —none of which appears in the 1870 census. It should be noted in addition that while servants have declined in importance the proportion of waiters has greatly increased, indicating a growing tendency to patronize hotels, cafes, and restaurants. Thus waiters increased from 107,044 in 1900 to 228,985 in 1920.

Other changes in 1920 are less marked and quite in line with the past development of the various groups. In the farming class there was a slight *absolute* increase, but a slight *relative* decline. The decline was not nearly so marked as in the 1900 and 1910 censuses. The professional class continued the steady increase it has shown since 1870. It is now exactly twice as important relatively as in 1870. Proprietors and officials, lower salaried, and industrial wage-earners—all subject to the influence of increasing industrialization—show increases quite similar to those previously registered in earlier censuses. The lower salaried class especially has been growing in importance, increasing nearly 40 per cent relatively to other classes from 1900 to 1910, and over 50 per cent from 1910 to 1920. This group is now nearly four times as important relatively as in 1870. The industrial wage-earning class increased relatively in much the same ratio that it has shown since

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[1] Census of 1910, Vol. IV, pp. 26–29.

1870. The following table shows the increase for each period in the proportion of the total gainfully employed which were industrial wage-earners.

| | |
|---|---|
| 1870 to 1880 | 14.3 per cent increase |
| 1880 " 1890 | 6.6 " " " |
| 1890 " 1900 | 9.0 " " " |
| 1900 " 1910 | 8.2 " " " |
| 1910 " 1920 | 11.1 " " " |

The "urban upper and middle" classes, including the proprietors and officials, professional and lower salaried groups, have increased from 19.2 per cent of the total gainfully employed in 1910 to 23.8 per cent in 1920. The "urban workers," including the industrial wage-earners and the servant groups, have increased from 42.3 per cent in 1910 to 45.5 per cent in 1920. On the other hand the "rural group," including farmers and farm laborers, has decreased from 32.4 per cent in 1910 to 25.5 per cent in 1920.

## BRITISH BANKING STATISTICS

By W. F. Crick, *University of London*

One of the most striking characteristics of the scientific treatment of banking in the United States is the wealth of statistical material which is placed at the disposal of those professionally or academically interested in the subject. By contrast with this enormous stock of material the British banking statistics are woefully inadequate. The underlying explanation of this obvious contrast is of course the system of bank examination which has grown up throughout the period of American banking history, and the legal insistence upon the submission of periodical statements of financial condition. The National Bank Act and the Federal Reserve Act—to deal only with federal requirements—have given rise to an admirable body of evidence for use by the practical economist. The current reports supply an excellent basis for the interpretation of the present as an index of the future, without which the equipment of any far-seeing banker or business man is incomplete.

In Great Britain, however, with the exception of the statements of the Bank of England and the half-yearly statements of the other joint stock banks, there is no legal requirement whatsoever as to the publication of accounts. This fact is reflected in an excessive disposition to secrecy on the part of the British banker, which gives rise not only to an unwarrantable liability to public criticism, but also to insuperable obstacles to such detailed scientific analysis as is made possible in this country.

Herein lies a fundamental cleavage between the personnel of banking and its place in the economic structure of the United States and in that of Great Britain. The British banker, trained as a specialist from youth and very frequently the representative of a long line of banking ancestors, relies on tradition and instinct for much of the guidance which the American seeks in facts and figures. The American banker, often enough, is far from being solely a banker. The needs of the locality in which he works, and the impossibility of the thorough subdivision and specialization of functions that is a feature of the large American as well as the British banks, bring him into direct concern with the broader economic problems of his own community. Moreover, the "free" banking system cultivates an intense individualism and a self-reliance which demand a supply of something more tangible than tradition and instinct on which to base decisions.

In America, too, the conception of banking as a public function is much more widely diffused and recognized than it is in Great Britain. It is difficult to conceive of a member of the British Parliament attacking the "deadly deflation policy" of the Bank of England, and a general election fought on the issue of a single or double monetary standard can only be imagined as a fantastic illusion conjured up by a magician with a predilection for financial subject-matter. Public interest in banking as a vital part of the economic mechanism is in Great Britian practically non-existent. Hence there is no call for the publication of banking statistics, except the demand of distracted economists and students, such as would certainly arise in the United States should the present publicity be curtailed.

The *Federal Reserve Bulletin* and the reports of the Comptroller of the Currency, the Federal Reserve Board, and the State Bank Commissioners are incomparable for their wealth of detail and clarity of exposition. Moreover, their compilation by impartial agencies, and the irregular periodicity of the Comptroller's reports, makes "window-dressing" a more difficult operation than was the case under the old British system. Hence the problem for the investigator is not by any means that of amplifying or increasing the available data, but rather of interpreting and searching for their exact implications. The foreign observer, in particular, often fails to see the wood for the trees. The trees are admirably cultivated, but that only tends to make the foliage thicker. The problem in England, on the other hand, is to secure any statistics that will form a reasonably sound basis for considered deduction.

Accordingly, for the benefit of American business men and students who may profit from a skilfull study of the British bank statements from time to time, it may be of use to clear up some frequent causes of misconception, to fill in some of the pitfalls which lie in the path of the investigator, and to call attention to a comparatively new, and therefore almost unrecognized, source of banking information.

## I

The weekly statement of the Bank of England is known and quoted everywhere as indicative of the state of health of the British banking organism. It was said at the outset that one of the two types of statement required by law was that applying to the Bank of England. When it is remembered, however, that this requirement was prescribed in 1844, under the Bank Charter Act, at a time when some of what are now the most elementary conceptions of banking theory had scarcely been formulated, it is not to be wondered at that this weekly statement is hopelessly antiquated. The Act prescribed that an account of notes issued, of the securities and gold and silver coin and bullion in the Issue Department, of the capital stock and deposits, and the money and securities in the Banking Department was to be published weekly in the *London Gazette*. The following is the form of statement used:

### BANK OF ENGLAND

An account pursuant to the Act 7 and 8 Vict. c. 32, for the week ending on August 9, 1922

Issue Department

| | £ | | £ |
|---|---|---|---|
| Notes issued | 144,029,625 | Government debt | 11,015,100 |
| | | Other securities | 7,434,900 |
| | | Gold coin and bullion | 125,579,625 |
| | £144,029,625 | | £144,029,625 |

Banking Department

| | £ | | £ |
|---|---|---|---|
| Proprietors' capital | 14,553,000 | Government securities | 43,032,505 |
| Rest | 3,483,082 | Other securities | 75,450,390 |
| Public deposits | 16,238,919 [1] | Notes | 18,487,415 |
| Other deposits | 104,500,212 | Gold coin and bullion | 1,820,255 |
| Seven-day and other bills | 15,352 | | |
| | £138,790,565 | | £138,790,565 |

August 10, 1922 Signature of Cashier.

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[1] Including Exchequer, Savings Banks, Commissioners of National Debt, and Dividend Accounts.

The first statement, by itself, tells us nothing. The items "Government debt" and "Other securities" always total £18,450,000—the amount of notes permitted to be issued against securities. Even the term "Notes issued" does not by any means give ground for thinking that there are £144 millions of Bank notes in circulation. If the second statement be consulted it will be found that some £18½ millions are held in the Banking Department. Furthermore, by government accounts (which will be dealt with at a later stage), published independently, it is shown that over £21 millions are held in the reserve against currency notes. Hence, in fact, only £104½ millions are outside the Bank. It is still impossible to say how much of this amount is in actual circulation. A great part of it is held by the other banks as a part of their cash reserves, and no discrimination is made between notes and coin in the returns of these banks. These defections in the statistics are not obvious, and hence it is easy to jump at the conclusion that the public is making use of £144 millions of Bank of England notes.

Turning now to the second statement, the mysterious item "Rest" merely represents undivided profits, and hence, for all practical purposes, using the term in its accounting as opposed to its banking sense, reserve. This item simply serves as an indicator of the size of the next dividend, since the reserve is never allowed to fall below £3,000,000 and naturally increases as the time for a dividend declaration approaches. The deposit items are self-explanatory. Prior to 1877, however, they were much more instructive, for the item "Other deposits" was split up into bankers' balances and private deposits. These figures clearly gave a much better indication of the available credit power of the banks. Now they are practically worthless, for they fluctuate, not primarily through economic causes, but inversely in relation to each other. The reason is clear, in that the functions of the Bank as fiscal agent of the government bring about frequent transfers from one to the other, as, for instance, when income tax is paid, or the interest on government securities. Any extraordinary rise, such as that occasioned by war exigencies, does of course testify to an expansion of credit, but it is altogether too complicated a figure to be used as even an approximate index of the extent to which credit has been extended. The last item, notably small, but formerly of much greater magnitude, consists mainly of Bank Post Bills, a form of acceptance used for transmission purposes. A curious relic of the days of highway robbery in England, it now has the character, when accepted, of a bearer instrument.

The items on the assets side are more complicated. The word "securities" is used in a very broad sense, a sense altogether out of touch with modern terminology. Thus "Government securites" includes not only long-time investments but Exchequer Bills, Treasury Bills, and even Ways and Means Advances to the government. Here are at least two fundamentally distinct classes of assets, hopelessly mixed. The next item is similarly constituted. It comprises not only long-term securities not issued by the government, but also bills discounted and all advances other than those extended to the government, quite apart from any question of the security behind them or their tenor. Nothing, therefore, can be gained from an examination of these items, except the fact that an increase in both *usually* betokens an expansion of credit, although it *may* quite as well mean increased holdings of long-term securities. From the point of view of the investigator the distinction made is not the one he would prefer. A separation of investments from bills and advances would be of much greater value than the present distinction between the persons liable on the instruments.

It is from these two items that the Bank's "ratio" is calculated. For all practical purposes the Bank note is a gold certificate. Hence the notes and coin held in the Banking Department are the cash reserves against the liabilities of the department. The liabilities against which they are held are simply the deposits. Hence the last two items on the assets side, divided into the sum of the third and fourth on the liabilities side, give what is perhaps the most important of the Bank's published figures, the "reserve ratio."

## II

The condition of the joint stock banks is a much better criterion of credit conditions in the country than the statement just described, for, although the Bank of England is not so exclusively a "bankers' bank" as are the Federal Reserve Banks, yet it has comparatively little direct contact with the public. The outside banks, in contradistinction, are purely bankers for the public, and hence reflect the activities and sentiments of the public much more accurately, since directly, than does the Bank of England.

The joint stock banks, in addition to their half-yearly detailed balance sheets which, in common with all corporations, they are required by law to compile,[1] began a few years before the war to issue monthly statements. These were discontinued during the war, when they would have been invaluable, and have been resumed only since January, 1921.

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[1] The Companies (Consolidation) Act, 1908, requires all public companies to file annually with the Registrar of Joint Stock Companies a "statement in the form of a balance sheet." These statements are almost invariably published, though it is not yet definitely established whether publication is a legal requirement. (See L. R. DICKSEE: *Advanced Accounts*). A banking company, however, is specifically required to exhibit publicly, semi-annually, a statement of capital, liabilities, and assets.

With the limitations of date to which they are subject, these figures are very valuable. The banks differ among themselves, as would be expected, in matters of detailed presentation. Nevertheless, the separate statements permit of combination into tables which, though imperfect, are better than anything previously supplied. The composite figures[1] are compiled from the averages of the weekly returns which constitute the monthly reports of the individual banks. It is significant that these statements seem to have eluded the attention of American economic and financial periodicals which supply current information regarding conditions in foreign countries. The *Federal Reserve Bulletin* supplies a part of these data, but by unofficial publications they are practically ignored. Yet the figures are, in reality, much more significant than those of the Bank of England. The items on the liabilities side are quite straightforward. They include paid-up capital; reserve fund; notes in circulation; current, deposit, and other accounts; and acceptances. While it would be very valuable to have the current and deposit accounts separated, this combined figure is of much greater value than the figures of the Bank of England as a rough index of the volume of credit in existence. The assets comprise coin, bank and currency notes and balances with the Bank of England; balances with, and cheques in course of collection on, other banks in Great Britain and Ireland; money at call and short notice; investments; bills discounted; advances; liabilities of customers for acceptances; bank premises; and investments in affiliations. The first two items, of course, might be improved by further subdivision. The present condition of the Bank of England's ratio makes it very desirable to know how much of this most liquid of the banks' assets consists of coin, how much of notes, and how much of Bank balances. The second, again, is an unfortunate combination of two items that it might be desirable to separate.

It is difficult to make any very close comparison between these statistics and those published in America. The data relating to the Federal Reserve Banks are clearly out of the question, and the statements of the national banks are issued only five times yearly and include only one third of the total number of banks in the country. Probably the statements of the reporting member banks of the Federal Reserve System are the most directly comparable. The nine London clearing banks, with their branches all over the country, probably perform quite as large a proportion of the country's business as do the 800 reporting member banks in the United States. Moreover, the frequency of these reports, and the fact that they are compiled from returns supplied by the banks themselves, facilitate direct comparison.

[1] Published in the *Monthly Review* of the London Joint City and Midland Bank, and elsewhere.

For purposes of such comparison several of the items in the American figures would have to be thrown together, since subdivision is not carried so far in the British reports. Thus, "net demand deposits," "time deposits," and "government deposits" would have to be combined in order to compare with the British "current, deposit and other accounts." Again, "reserves with the Federal Reserve Banks" and "cash in vault" would have to be combined to correspond with the British "coin, bank and currency notes, and balances with the Bank of England." The comparison, however, falls short of completeness, owing to the omission of some items in the member banks' reports, such as "capital" and "bank premises," which appear in the British statistics. But in any case the comparison cannot be a close one.

For internal purposes, however, these statements are a distinctive and valuable contribution to banking data. Not the least of their valuable characteristics is the fact that they are now free from the charge of "window-dressing." Before these statements were issued it was almost universally recognized that the banks regularly contracted their advances and increased their Bank balances specifically in order to make a good showing in their half-yearly returns. Critics of the statistics are now disarmed, however, by the fact that the monthly figures are averages of weekly returns. It would clearly be impracticable for the banks to "dress their windows" four or five times a month. Hence it may fairly be argued that the returns as now published do not tend to exaggerate the liquidity of the banks' position.

## III

In addition to these two sources of information there are two others of some interest and value. They are the clearing house returns and certain parts of the Government returns, issued weekly. The report of the London Clearing House is, naturally, the most important. The banking business of Great Britain is concentrated in London to a much greater extent than the banking business of the United States is concentrated in New York.[1] Hence the London returns furnish a more accurate index of the volume of business in England than the New York returns do of the volume of business in the United States. On the other hand, the London figures are affected so much by speculative activity that the elimination of this element cannot be effected as easily as in the United States by using country clearings. It is true that the London Clearing House differentiates between "Town" and "Country" clearings, but even this discrimination is largely nullified by the fact that so much country business is financed through London that much of the provincial activity reflects itself, in monetary terms, in the Town clearings.

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[1] The returns of the London Clearing House, for example (as quoted by the *Economist*), showed a total of clearings for the year 1922 up to August 16 of £24,249,921,000, while those of the 11 leading provincial houses together in the same period reached only £1,269,843,600. By contrast, the New York clearings (according to the *Commercial and Financial Chronicle*) for the week ending August 19, 1922, totalled $3,027,100,000, which was less than the combined total for all other cities, viz., $3,587,486,621. Statistics of clearing operations of the Federal Reserve Banks and debits to individual accounts give additional support to this distinction.

The Government Returns, so far as they relate to credit conditions, are useful in two ways. The Currency Notes Account gives the total of notes outstanding, and the gold, Bank of England notes, and securities behind them. The total of notes is a useful index of the volume of currency in circulation, though it is by no means exact, since some of the notes form part of the reserves of the other English and the Scotch and Irish banks. The Treasury Bills Account is useful indirectly. It shows not only the amount of bills offered and applied for during the past week, but also the average rate at which they were discounted. This is a fair index of the direction in which money is flowing, for, if the rate be £2 2*s* 0.9*d* per cent, as it was during the week ending August 11, 1922, it may be inferred that business is less active than when, as in the week ending August 5, 1921, they were selling at £4 10*s* 10*d* per cent. This figure, however, must not be too hastily relied upon, for there enters into the question the fact that the total of Treasury Bills offered has fallen very considerably, thus indicating that the demands of the government for this type of short-term money has decreased.

Besides these official figures there are various unofficial sources of financial materials for those interested in British economic conditions. The London Joint City and Midland Bank, for instance, compiles monthly figures of new capital issues, and produces the combined tables of the deposits, advances, etc., of the nine London clearing banks. The *Economist* tabulates the daily average prices of gold and silver. The *London Times* compiles weekly averages of the exchange rates on important financial centers. The British *Economic Review* issues an index of security prices. The London School of Economics (University of London), in addition to performing a similar tabulative and interpretative service to that undertaken by the Harvard Committee on Economic Research,[1] calculates a short money index from the averages of the Bank rate, bankers' deposit rates, three-months bills, and day-to-day rates.

Nevertheless, British statistics are notoriously inadequate. It would assist both business men and economists enormously in these days of increasingly scientific execution of the world's material affairs if the British banks would agree to issue statistics that would bear comparison with those now published by the member banks of the Federal Reserve System. It is confessedly a forlorn hope. Hence a proper understanding of the sparse information now available is especially essential to American and other foreign investigators.

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[1] See the *Manchester Guardian Commercial*, Special Reconstruction Numbers. The work is under the supervision of Professor A. L. Bowley.

# THE PROBABLE ERROR OF THE DIFFERENCE BETWEEN TWO DIFFERENCES

By J. Arthur Harris

Given measures of two pairs of variables, $w$, $x$, and $y$, $z$, it is sometimes necessary to determine the probable error of the difference, $d_1-d_2$, where $d_1=x-w$, $d_2=z-y$.

A formula has doubtless been given somewhere in the extensive literature, but I do not recall having seen it. Since it must involve the value of $r_{d_1d_2}$ when there is any reason to suspect that the two differences may be correlated, a highly convenient method (which may be used when the correlations between the variables themselves are required and when variation and correlation are such that the ordinary theory of probable errors may be employed) is that based on the moments and product moments of the original variates, taken about 0 as origin. The formula for $r_{d_1d_2}$ has already been suggested[1] and employed in the study of growth increments.[2]

The moments $\Sigma(w)$, $\Sigma(w^2)$, $\Sigma(x)$, $\Sigma(x^2)$, . . ., and the product moments $\Sigma(wx)$, $\Sigma(wy)$, $\Sigma(wz)$, $\Sigma(xy)$, . . ., are generally required for other purposes of the investigation.

The constants for the differences are given by well-known formulas:

$$\bar{d}_1=\bar{x}-\bar{w},$$

$$\sigma_{d_1}^2=[\Sigma(w^2)+\Sigma(x^2)-2\Sigma(wx)]/N-\bar{d}_1^2,$$

and similarly for $d_2$, where the bars denote means and the sigmas denote standard deviations.

The product moment from which $r_{d_1d_2}$ may be deduced is given by

$$\Sigma(d_1d_2)=\Sigma(wy)+\Sigma(xz)-\Sigma(xy)-\Sigma(wz).$$

The standard deviation of $d_1-d_2$ may then be written

$$\sigma_{(d_1-d_2)}^2=\sigma_{d_1}^2+\sigma_{d_2}^2-2r_{d_1d_2}\sigma_{d_1}\sigma_{d_2}.$$

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[1] Harris, J. Arthur, "Formulae for the determination of the correlation of size and of growth increments in the developing organisms." *Proc. Soc. Exp. Biol. Med.*, Vol. XVIII, pp. 4–5, 1921.

[2] Harris, J. Arthur, and Reed, H. S. "Inter-periodic correlation in the analysis of growth." *Biol. Bull.*, Vol. XL, pp. 243–258, 1921.

## RECENT ACTIVITIES OF THE CENSUS BUREAU

June 30, 1922, marked the termination of the three-year decennial census period within which, under the census law, the reports of the Fourteenth Decennial Census were to be completed and published. By that date the manuscript and the statistical tables for all the reports had been sent to the printer, and all the fundamental statistics and many of the detail figures had been published as bulletins or advance press statements. There remained the reading and checking of the printer's proof for a number of large quarto volumes and the preparation of several monographs analyzing the statistics.

The Bureau has thus established a record in census taking, as it is safe to say that at no preceding census has the public been supplied with such an array of facts concerning population, social conditions, and industrial activities so promptly after the data were collected and within the period prescribed by law. The Bureau has issued seven series of state bulletins in connection with this census, two on the subject of population, one on agriculture, one on manufactures, one on mines and quarries, one on irrigation, and one on drainage. These series have all now been completed and published with the exception of the series relating to manufactures, for which a few state bulletins are still in the hands of the Government Printing Office. Of the eleven quarto volumes constituting the final reports of the Fourteenth Census, three have been printed, namely, Volume I, *Number and Distribution of Inhabitants*, giving the population of states, counties, incorporated places, and other minor civil divisions; Volume III, which comprises the state bulletins giving the population classified by sex, race, nativity, and age, together with statistics of illiteracy, school attendance, citizenship (naturalized or alien) of foreign-born, and dwellings and families; and Volume VII, which comprises the state bulletins for agriculture and is issued in three parts, one part for the Northern, one for the Southern, and the third for the Western states.

Of the projected series of interpretative studies or monographs, one, that on *Increase of Population* by William S. Rossiter, is in type and nearly ready for publication. The other monographs which are in various states of preparation include: *Recent Growth of Manufactures*, by E. E. Day, of Harvard University; *Recent Growth of the Mining Industries*, by G. A. Roush, of Lehigh University; *Immigrants and Their Children*, by Niles Carpenter, of Harvard University; *Illiteracy*, by Frank A. Ross, of Columbia University; *Farm Mortgages*, by Jesse E. Pope, of Washington; *Farm Tenancy*, by E. A. Goldenweiser, of Washington; *Wages in Manufacturing Industries*, by Paul F. Brissenden, of Columbia University; *Children in Occupations*, by Alba M. Edwards, of Washington; and *Women Housekeepers*, by Miss Bertha Nienburg, of Washington.

A large part of the force of the Census Bureau at the present time is engaged upon the first biennial census of manufactures, which relates to the year 1921 and is taken in accordance with the provisions of a clause in the Fourteenth Decennial Census Act which authorizes the Director of the Census to collect and publish statistics of the products of manufacturing industries every two years. The schedule is much briefer than the one used for the general census of manufactures taken quinquennially, but it includes the number of wage-earners, the total wage payments, period of operation, cost of material, value of products, and in the case of many products, the quantity as well as the value. The results are being given out in the form of press summaries as rapidly as the work is completed, but as yet no printed report or bulletins have been issued.

In the meantime, of course, the Bureau is continuing its regular annual inquiries with regard to births, deaths, financial statistics of states and cities, and production and stocks of cotton, leather, skins and hides, and various other commodities.

The Bureau is making plans for the decennial census of wealth, public debt, and taxation, which will be taken next year and will cover the following subjects: Public indebtedness of the nation, states, and other civil divisions, 1923 and 1913; assessed valuation of property and amounts and rates of levy, 1860–1922 (for states, counties, municipalities, and other civil divisions); taxation and revenue systems of state and local governments; national and state revenues and expenditures, 1923 and 1913; county revenues and expenditures, 1923; municipal revenues and expenditures, 1923; and estimated valuation of national wealth, 1850–1922 (by states).

Preliminary work on this subject was begun last July, and it is expected that the section on taxation and revenue systems of state and local governments will be ready for publication before the close of the present fiscal year. Dr. Willford I. King, of the National Bureau of Economic Research, has consented to act as consulting expert for this inquiry, particularly with regard to the difficult problems of making an accurate estimate of national wealth. Other authorities will also be consulted regarding the scope of the inquiry and the methods to be followed.

Another important inquiry to be taken up next year is the census of defective, dependent, and delinquent classes. This includes in its scope the insane in hospitals, sentenced prisoners in prisons, jails, and reformatories, paupers in public almshouses, and feeble-minded in institutions for that class. It involves having a schedule filled out for each inmate present and each commitment or admission, giving age, sex, nativity, marital condition, and other data, including in the case of prisoners, offense and length of sentence, and in the case of the insane, the psychosis or type of mental disease. It should be added that the Bureau has not yet determined definitely the detail to be covered by these inquiries, but while the schedules to be used have not yet been formulated they probably will not differ very greatly from those used in the last preceding census of institutional classes.

In making the plans for the census of institutions and institutional classes the Bureau has held conferences with representatives of the National Committee for Mental Hygiene, the Child Welfare League of America, the American Institute of Criminal Law and Criminology, the National Probation Association, and other organizations and institutions.

A census of benevolent institutions is also to be taken next year. This covers orphanages and other institutions for children, homes for adults, hospitals, dispensaries, and institutions for blind and deaf. No individual schedules regarding the inmates or admissions will be filled out except possibly in the case of institutions for children, but the report will give the institutional population on a given date, the number admitted during the year, the number discharged, and probably the receipts, payments, and value of property.

The Bureau is also planning to collect statistics of marriage and divorce relating to the year 1922. It is expected that this inquiry will be continued annually hereafter. As regards marriages, the Bureau heretofore has never done more than ascertain the number, but this time it is probable that a certain amount of detail will be compiled for those states where such detail is available in the state records. As regards divorces, the schedule will call for date of marriage; date of filing petition; who was libellant (whether husband or wife); whether case was contested; date of decree or judgment; number of years married; cause of divorce; kind of divorce (whether absolute or limited); number of children affected by decree; and whether alimony was granted. The following questions contained on the previous divorce schedules will be omitted this time: Date of separation; how notice was served (whether personally or by publication); whether intemperance was an indirect cause when not direct; and whether alimony was asked.

## METHOD OF COLLECTING FINANCIAL STATISTICS OF CITIES AND STATES

Financial statistics of cities were first collected by the Bureau of Labor, under an Act of Congress approved July 1, 1898, which authorized the Commissioner of Labor "to compile and publish annually, as a part of the Bulletin of the Department of Labor, an abstract of the main features of the official statistics of cities of the United States having over 30,000 population."

The reports prepared by the Bureau of Labor for 1898, 1900, and 1901 covered a number of subjects, but always included the financial statistics; and since this work was taken over by the Bureau of the Census, in 1902, the financial statistics have been collected every year with the exception of 1914 and 1920, which years were unfortunately omitted on account of the press of the decennial census work. The statistics include the total and per capita receipts from revenues; total and per capita payments for expenses, interest, and outlays; total and per capita indebtedness; estimated true value and assessed valuation of property; and taxes levied, rates, methods of assessment, etc. Descriptions of accounting terminology and suggestions for uniform classification are also included. For a number of years reports were also published covering so-called physical statistics, such as statistics of police departments, fire departments, streets, charities, schools, and water, gas, and electric light systems, etc.

Financial statistics of states similar to those for cities were collected for the first time in 1915 by order of the Secretary of Commerce, and since then they have been collected annually, except in 1920.

From 1902 to 1921 the field work was performed entirely by agents of the Bureau of the Census who were sent to the cities and states. No assistance was asked of the city and state officials except that they permit access to their records and explain any ambiguous entries in these records. The entire expense of the inquiry was borne by the Bureau of the Census.

These reports have proved to be of special assistance to the cities in the detection of antiquated methods and extravagant practices, and they are used extensively in the discussion of systems of taxation and improved methods of accounting. This being the case, it seemed only reasonable that the cities should bear part of the cost of the work. Accordingly, in 1921 the Bureau requested the city and state officials to coöperate to the extent of filling out the schedules, which work had heretofore been done by the agents of the Bureau. The Bureau was to compile and publish the reports as before. This new plan for securing the statistics was adopted at a time when agents of the Bureau were already in the field and considerable progress had been made in securing returns for the 1921 reports. The agents were directed to complete the reports on which they were then engaged, and to advise with the officials of other cities and states, rendering such assistance as might be necessary where the officials expressed a willingness to comply with the Bureau's request in future years but were unable to prepare the schedules required for the 1921 reports. The Bureau, when requesting the cooperation of officials, recognized the fact that a very considerable concession should be made in reducing the amount of work from that formerly required in the preparation of reports. Accordingly, new schedules, very much simpler than those formerly used, were prepared and mailed to the officials of the cities and states. As a result of this plan the Bureau obtained reports for 183 of the 253 cities having a population of over 30,000, and for 30 of the 48 states. Of the 183 cities included in the report, 33 were prepared by city officials, 21 from the annual reports of the cities and through correspondence with the officials, and the remainder by agents of the Bureau. However, the officials of only 14 of the 70 cities not included in the 1921 report refused to undertake to prepare the schedules; others first agreed to do so but failed to carry out their agreement, as no data were received; and in other cases where the work was undertaken the schedules sent into the office were in such condition that they could not be used even after the most extensive correspondence.

There were five states of the 18 not included whose officials refused to undertake to prepare the schedules. Reports for 27 of the states included in the 1921 report were prepared by the agents of the Bureau; reports for two states, California and New Jersey, were compiled by state officials; and for one state the data were taken from the printed reports, supplemented by information secured through correspondence with state officials. In almost every instance where the officials refused to prepare the reports they stated that they desired to coöperate but they did not feel that it was possible for them to prepare the reports properly, or they did not have sufficient clerical assistance. The net result of this plan was unsatisfactory.

In view of this experience the Census Advisory Committee recommended that the former method of collecting statistics be resumed, namely, the collection of data by agents of the Bureau of the Census, and that the statistics be placed on detailed schedules.

This matter was discussed at the meeting of the National Association of Comptrollers and Accounting Officers, composed principally of city officials. The discussion developed the fact that the members of the association and others interested would not have the same degree of confidence in reports prepared by state and city officials as in those compiled by a Federal agency, such as the Bureau of the Census. The contention was that city and state officials would be inclined to present the figures of their city or state in such a manner as to show the financial transactions of their respective governments in the most favorable light. Furthermore, it was thought that the several city officials could not prepare comparable reports. The Association accordingly adopted a resolution to the effect that the census reports on financial statistics of cities and states should be compiled by agents of the Bureau of the Census.

The Bureau of the Census, however, still feels that it is only reasonable that the various cities and states should bear a part of the expense of this undertaking which is costing the government about $100,000 annually, of which approximately $45,000 represents the cost of field work; and it is only fair to add that the city officials in 1921 very generally expressed a willingness to assist in any practicable way. Accordingly, it is proposed that in the future the Bureau send an agent to each city and state to be canvassed, with the distinct understanding that the city furnish clerical assistance to the agents of the Bureau, thereby reducing materially the expense of collecting the statistics in the field. Undoubtedly the National Association of Comptrollers and Accounting Officers can accomplish this by a persistent campaign among the officials in the different cities and states. Each state and city should designate a clerk familiar with their books to assist the representatives of the Bureau in compiling the census schedules. Upon this basis it is the intention to continue the work as recommended by the Census Advisory Committee, the National Association of Comptrollers and Accounting Officers, state and city officials, and others who are interested in public finance.

## STATISTICS ON EMPLOYMENT: A REJOINDER

The idea in my footnote [1] at which Mr. Hornell Hart apparently took offense in his reply in the September JOURNAL [2] was not the result of any hasty or "careless" judgment on my part, but of long and careful consideration. I welcome the opportunity of stating more fully my objections to his method and of discussing his objections to mine—despite the unprofessional tone which he has chosen to use.

Giving attention to the four so-called "eccentricities" which Mr. Hart begins by pointing out:

(a) The first must, I think, be ignored, as Mr. Hart does not specify the incorrect footnote reference nor any of the misquotations, which of course I should have been glad to correct if proved.

(b) Mr. Hart's next objection is obscure. My point was that the typical behavior of the metal industry in reflecting the general industry cycle is even more strikingly demonstrated by employment than by production data. The coefficients in question were respectively 90 and 85 per cent. My statement as quoted by Mr. Hart is both correct and clear, so far as I can see.[1]

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[1] This JOURNAL, Mar., 1922, p. 42, note 5.

[2] Pages 385–391.

(c) Mr. Hart seems greatly to overrate the importance of always stating the probable error of correlation coefficients, because, whether the number of items be large or small, the probable error itself has a probable error, and moreover the very statement of a so-called probable error leads many persons to overlook the errors in the original data, which may be equally or more important. It is no oversight, as Mr. Hart implies, but a deliberate opinion on the part of many other writers as well as myself that the use of probable errors is very much overemphasized in time series of economic data.

(d) Mr. Hart is in error in expecting to find the mean of every cycle series 0.0 and its standard deviation 1.0. Indeed in many instances there would be ground for alarm if this were the case! The secular trend of a series is determined by the data embracing as nearly as possible some whole number of cycles. Once constructed, this trend may be extrapolated for short periods at either end of the base period for series which, like the ones under discussion, disclose little or no change of trend. This is a common and legitimate device, employed by Professor Persons and other leading students of time series for studying an index during parts of cycles adjacent to the original period. Therefore it ought not to seem disconcerting but perfectly natural to Mr. Hart that frequently $a \neq 0$ and $\sigma \neq 1$. Naturally, in computing correlation coefficients allowance is made for this fact by using the correction formula.

In appraising the numbered points to which Mr. Hart next proceeds, several considerations should be borne in mind:

Mr. Hart states in his discussion of point 2 that "correlation with business indexes cannot be considered an adequate criterion for judging the value of unemployment indexes"; and yet under point 1 he used such correlation of employment indexes with prices (65 *vs.* 52 per cent) as a condition sufficient "to remove any basis for supposing that Mr. Berridge's index deserves to be substituted," etc. These are clearly irreconcilable ideas.

In particular, price is an especially poor criterion for testing any index of employment because of the differences in their economic nature—one is predominantly physical while the other is not.[2] Professor Persons and Miss Coyle would be the last to claim that their ten-commodity index of prices measures *actual* industrial activity; prices are only an indirect measure. On economic grounds production is clearly much better suited as a test of the validity of employment indexes, though even here a higher correlation certainly does not *of itself* prove greater validity. Thus the employment index based on data for three states, which I showed in the June issue of this JOURNAL,[3] is more highly correlated with pig iron production than is the New York index (89 *vs.* 85 per cent), but this fact is not enough to prove the superiority of the former without carefully considering the *a priori* grounds for accepting its components. For these reasons Mr. Hart's correlations of employment with prices are wholly inconclusive.

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[1] The reader may judge for himself by referring to the original context, *Rev. of Economic Statis.*, prel. vol. 4, Jan., 1922, pp. 23, 24, including footnote 24. Compare Edmund E. Day, "An Index of the Physical Volume of Production," *Rev. of Economic Statis.*, prel. vol. 2, Dec., 1920, p. 367. As for the term "per cent," I see no essential difference between it and "hundredths," if this is Mr. Hart's point.

[2] For further discussion see *Rev. of Economic Statis.*, prel. vol. 4, pp. 24, 38–9.

[3] Page 236, Chart 4.

I cannot accept Mr. Hart's third argument, in favor of including all kinds of unemployment in the final index. It seems to me a cardinal tenet that unemployment due to depression, season, sickness, labor disputes, etc., forms not one problem but a series of very different problems, which should be studied separately as far as possible. True, I have not published any paper dealing with these types; but I have by no means "discarded" them. A final re-combination of all these factors is not only unnecessary but undesirable.

Practically all of Mr. Hart's fourth criticism seems to me beside the point, because it presupposes that I have been trying to measure the volume of unemployment, or at least the absolute numbers unemployed—an aim which I have disavowed repeatedly and emphatically. On the other hand, my purpose has been to develop as accurately as I could a picture of the *fluctuations* by using the index method.

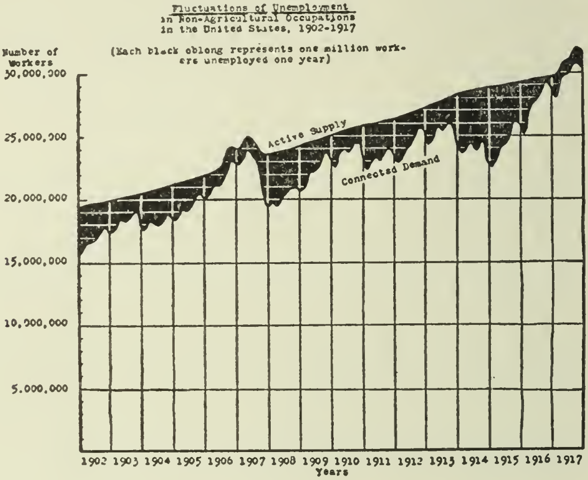
Under point 5, I agree that the samples which I have used in my index are not extremely large, though the three states comprise more than one fourth of the industrial activity of the entire country; but I deny that they are "biased."[1] I sought, for use in the index, only those data which seemed sure or at least likely to merit such treatment. Mr. Hart, on the other hand, accepted numerous data which I regard as untrustworthy for my purpose, and even more so for his; and other materials which are so fragmentary as to be safely used only as supporting evidence he has grafted directly into his measurements. Without rigorous selection of data it is impossible to obtain reliable results. As in my original reference to Mr. Hart's monograph, I concede its outward "comprehensiveness," and maintain that he paid dearly for this by accepting unsuitable materials. Comprehensiveness won on such terms is but an empty virtue.

Another important source of error, in addition to the uncritical selection of data, lies in the way Mr. Hart has attempted to use his data. One advantage of adopting the index method is that we thereby avoid the measurement of aggregates. Mr. Hart, however, has sought to measure (a) the aggregate volume of connected demand for labor, (b) the aggregate supply, and by subtracting the first from the second, (c) the aggregate volume of unemployment (see accompanying chart). In measuring connected demand, for instance, he attempted to translate data drawn from twenty-one distinct sources[2] into estimates of the absolute number of persons employed in each month from 1902 to 1917. A still further and perhaps even greater source of error lies in his determination of urban labor supply. This is based on annual estimates of population, birth and death rates, migration, etc., modified in an abrupt and somewhat arbitrary manner in 1906–7 and 1917 (see chart). I would go even further than Mr. Hart in pointing out variables that would have to be measured in order to obtain a base

[1] Mr. Hart greatly exaggerates the differences among industries as to the normal timing of employment cycles. For evidence on the similarity among localities see this JOURNAL for June, page 232.

[2] Enumerated on p. 49 of his monograph, from which the chart is also taken.

line suitable for the purpose he has in mind; indeed they are so numerous, and so imperfectly represented in available statistics, that I regard the problem as virtually an indeterminate one. If the secular trend is, as Mr. Hart claims, a "crude and unsatisfactory" datum for measuring the fluctuations of an employment index, then his supply line is still more "crude and unsatisfactory."



Finally, the method of obtaining a residuum by subtracting one of these large and unreliable absolutes from the other magnifies the seriousness of the errors in them both; this seems self-evident.

In view of all these considerations, I am unable to convince myself that my own methods or results have been affected at any vital point by Mr. Hart's attack, or that I should change my original verdict on his research.

W. A. Berridge

## A PROPOSAL FOR A STANDARD SERIES OF STATISTICAL REFERENCE BOOKS

For many years there has been a feeling among trained and experienced statisticians that standards of professional skill should be established in the statistical field comparable in a general way with those which are recognized in many other professions. Attempts have been made at various times to formulate such standards, but these attempts have resulted in little more than an increased realization of the difficulty of outlining professional requirements in a scientific field as broad and complex as that of statistics.

During the early part of the present year this question was brought up for consideration at a meeting of the Board of Directors of the Statistical Association. After considerable discussion it was agreed that the real need at present was not that of establishing a basis of certification for statisticians of varying degrees of professional skill, but was the more fundamental one of securing an agreement among academic and practicing statisticians as to the cultural background and the elements of descriptive and analytical statistical technique which should form the basis for a general statistical training. As the result of this conclusion a special committee[1] was appointed to consider the matter in further detail and to make its recommendations to the Association.

In approaching this very difficult assignment the committee's first effort was to determine the specific form that final action should take to be of real service to the statistical profession. It was obvious that a mere statement, in general terms, of the fundamental importance of cultural studies and of certain elements of statistical technique would be of little practical value at the present time. The immediate need of teachers, students, and practicing statisticians appeared to be for an authoritative and rather detailed outline of principles and practice in the elementary and intermediate rather than the advanced ranges of statistical science.

With the problem thus newly defined, the committee then undertook to survey in a general way the existing statistical treatises and textbooks in English. This survey indicated the existence of many excellent elementary and advanced texts, and of many valuable treatises on special statistical applications. There appeared, however, to be a distinct lack of what might be called intermediate texts, representing the dividing line between the skill of the statistical specialist and that knowledge of statistical principles and practice which should be the common property of all well-trained statisticians.

As a result of this survey, the idea developed that the Statistical Association might very properly undertake to fill the existing gap by securing the preparation of a coherent and properly related series of statistical reference books. A further study of the question indicated rather clearly that this series could not be expected to replace textbooks prepared for purposes of instruction in colleges and universities, nor could it be expected to replace advanced treatises on statistical methods and statistical applications. It seemed clear that the proposed texts should be designed primarily for reference purposes, and that it would be particularly necessary to have them prepared under such supervision as would make them represent in the subject-matter as a whole, and in the relative space assigned to the various elements of illustrative subject-matter, a sound and authoritative consensus of up-to-date statistical opinion and experience.

In continuation of its study of this problem the committee has developed a definite proposal which it is the purpose of this article to submit to the membership of the Association, in advance of the annual meeting, for their comments, criticisms, and constructive suggestions.

The proposal, in brief, is that there shall be appointed, at or following the annual meeting, a general committee on statistical reference works with a membership properly balanced between academic and practicing statisticians, and having power:

(a) To appoint an editor-in-chief and special editorial board, this board, except for the editor-in-chief, to be made up of the several writers who undertake to prepare individual texts.

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[1] **Consisting of L. I. Dublin and M. C. Rorty.**

(b) To appoint an advisory board, which shall coöperate with the editorial board in the preparation of the required texts.

(c) To select a publisher and determine an equitable basis for the apportionment of royalties as between and among the several writers and the editor-in-chief.

(d) To make initial recommendations to the editorial board as to the general scope and plan of the series of reference volumes.

It is the feeling of the present committee that the general committee should serve simply to organize the project in its initial stages and to select the permanent working organization as above indicated.

Consultation with various members of the Association indicates that the proposed series might properly include the following volumes:

1. Outline of statistical principles and methods
2. Statistical sources and the collection and tabulation of statistical data
3. Graphical presentation of statistical data
4. Graphical analysis of statistical data
5. Statistical mathematics. Theory of probabilities. Theory of sampling. Statistical accuracy and error
6. Frequency distributions and averages
7. Curve fitting and correlation
8. Statistical forecasting and the analysis of time series
9. Index numbers and other statistical indexes

The preceding titles are of course very tentative, and indicate only in a rough way the possible arrangement and scope of the several volumes.

It has further been suggested that the individual volumes be restricted, so far as practicable, to not more than 200 pages each, in order that the selling price of the series may be kept within reasonable limits. These and other details of the series may very properly be left for consideration by the proposed general committee and editorial board. However, it is the suggestion of the present committee that the initial volume, "Outline of statistical principles and methods," should consist, in the main, of a series of chapters directly related to the remaining volumes of the series. It is assumed in this connection that the writer of the initial volume will be in position to coöperate directly as to each chapter with the writer of the related volume in order to secure the necessary continuity of treatment.

The present thought is for the initial volume to include the range of descriptive and analytical operations that should be covered in elementary statistical courses for engineers, economists, sociologists, biologists, medical students, etc., as well as for those who expect later to specialize in statistical work. Also, in the office of the practicing statistician it is felt that the elementary text should serve as the primary reference work for "junior" statisticians and that the series as a whole should adequately cover the field for "statisticians" and "senior statisticians," leaving to advanced texts the field covered by statistical specialists.

For the purposes of the annual meeting, at which the plan will form the basis of a round table discussion, it will be helpful if members who are interested will mail promptly to Professor Robert E. Chaddock, American Statistical Association, Kent Hall, Columbia University, New York City, their comments and suggestions as to the proposal as a whole and in detail.

It should be noted particularly, in this connection, that it is possible for the series to be issued either under the auspices of the Association or as an independent venture to which the Association will not be directly committed. A notable precedent for direct action by the Association may be found in the work of the British Institute of Chartered Accountants in connection with actuarial science. On the other hand, there may be some members who would endorse the project as an independent venture, but who would be unwilling to see the Association assume direct responsibility.

## A COMMUNICATION

In the September number of this JOURNAL there appeared a review[1] of *Costs, Merchandising Practices, Advertising and Sales in the Retail Distribution of Clothing*, published by the Bureau of Business Research of the Northwestern University School of Commerce. Because the reviewer has so fully misunderstood the purposes for which this study was undertaken and the methods of realizing them, I am asking the Editor for permission to insert this brief note.

When the Bureau of Business Research undertook this study, it was done

> . . . with the distinct feeling that it would not be worth while, either for the Bureau or for the trade, to make a superficial investigation. Accordingly, the questionnaire . . . was comprehensive in outline and detail in the various points covered. . . . In view of the fact that the details were submitted, it would not be in keeping with the intent of the Bureau of Business Research, nor fair to those who furnished the information, to present the facts in a general and condensed manner.[2]

With this idea in mind, it was thought

> . . . not to be sufficient to group roughly all stores into a single class and to express costs and merchandising practices in the form of a single average or total. Averages, unsupported by the detail which make them up, or without reservations as to the diverse conditions which obtain, may be not only confusing, but also misleading. By giving more than averages, that is, by classifying stores into groups, according to size and location, by distinguishing them by cities and by positions within cities, and by treating the years 1919, 1918, and 1914 separately, each merchant, who has sufficient interest, may compare his own store with others similarly placed and judge of his own activities and costs in terms of those prevailing for the group to which he belongs.[2]

Other statements relating to the purpose of the study occur at various places throughout the different volumes.

The aim or purpose of undertaking this study was realized by reducing to a comparable basis the different conditions which seemed to be pertinent concerning each of the topics discussed. Accordingly, stores are fully classified by size and location, by position within cities, by types of buildings occupied, by floor space utilized, by types of goods sold, etc., the purpose throughout the different volumes being to classify the stores so that the averages would have as nearly as possible a clear and unmistakable significance. In other words, it was felt that only like things could be compared, and a definite attempt was made to group the stores with respect to conditions which were similar. Had the Bureau been content with crude generalizations, it would not have utilized more than 600 pages in which to describe the expenses and merchandising practices of retail clothing stores, nor would it have taken the pains in summarizing its results to call attention to the fact that the general figures which are given are significant only to the extent that they accurately characterize the details of which they are made up. It may be worth while, in this connection, to cite a typical expression which is found at various places throughout the study. In summarizing the contents of Volume 1, these words are used:

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[1] By Mr. H. K. Herwitz.

[2] Page 8.

> It (the summary) should be considered as a summary and read in connection with the corresponding parts in subsequent pages. To summarize briefly such a study as this requires broad generalizations and does not admit of all the conditions and limitations affecting the conclusions being enumerated. It can almost be taken to be a self-evident truth that general statements are inexact. It is hoped that the reader will not content himself with a hurried perusal of the summary. The really significant part of the discussion is not in the summary, but in the details which support it.[1]

Realizing the limitations of any brief summary as an accurate characterization of the different parts of the study, the different volumes[2] are provided with summaries at the close of each independent part. In these summaries, relating as they do to specific items of expense or trade practices, attention is frequently called to the variations in the averages for stores of different size, location, merchandising practices, etc., and to the fact that the averages do not reveal all of the peculiarities reflected in the data which they include. The reader repeatedly is urged to consult the various tables in the discussion and not to rely upon the summaries alone. Further evidence that the Bureau was unwilling to summarize the data by the use of averages of non-homogeneous groups is found in that part of Volume VI which relates to expense- and trade-tendencies. This summary features the different conditions which obtain for stores of different size, location, position, etc.

The reviewer of the study objects to the use of averages, as distinct from modes or medians, to characterize the conditions obtaining in the different store-groups. In so doing, he seems clearly to have misunderstood, or at least not to have appreciated, the purposes of the study and the methods of realizing them. Briefly, these purposes when put under two heads were: first, to establish the "absolute and relative amount of sales, rent, wages and salaries, advertising, etc., for stores of different size, location, age, merchandising and accounting methods," and second to determine "the tendencies of the amounts to decrease, increase, or remain constant as stores increase or decrease in size or change in location and operating conditions."[3] In order to realize these purposes, the arithmetic mean is the only simple measure that can be used. In many instances modes are indeterminate and medians of no significance. Some single precise unit had to be adopted. Modes would not have sufficed. Frequently there are no clearly defined modes. Indeed, from many points of view, the tendencies for amounts of expense, etc., to increase or decrease under different conditions of store operation are far more important than the actual amounts of expense at a particular time as revealed by any measure. Such tendencies can be measured satisfactorily only by the arithmetic mean. Time and again throughout the study, as noted above, merchants are not only advised but entreated not to compare their own expenses with those of all stores, but by using the index and table of contents to select those particular store-groups, those particular locations, sites, and operating conditions which most nearly correspond to those obtaining for their own stores, and even then to look upon the amounts of expense, etc., as only generally indicative of the conditions obtaining at the time or place discussed.[1]

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[1] Page 10. Similar statements are found on pages 103, 185, 269, 277, 388–89, 395, 496, 499, 571–72.

[2] Except Vol. I.

[3] Page 571.

The reviewer has compiled a table, for the different items of expense for *all* of the stores treated as a unit, wherein the averages differ markedly from modes and medians. To have prepared such a table rather than one in which the respective averages are computed for stores of similar size, location, position, etc., is to do precisely the thing against which the Bureau so frequently and painstakingly protested; that is, to take general averages in preference to those which represent the greatest detail obtainable for a particular situation. Moreover, the table compiled by the reviewer forcibly illustrates the difficulties which would have been encountered in comparing the stores in the detail which was required had the Bureau chosen to use modes or medians. In many cases modes or medians derived from the totals, even under the detail in which the stores are tabulated, would not have made it possible to have compared stores group by group. To base comparisons, as the reviewer does, on modes and medians for *totals* alone, as contrasted with those for the detailed groups, is inexcusable, because to do so involves averaging things which are patently non-homogeneous.

The study is also criticized because relatively few frequency distributions are given. The Bureau would like to have printed the frequency distributions not only for the totals but for every item of the detail. This, however, seemed unnecessary, and quite impossible within the amount of space available. Accordingly, it chose the method of classifying the stores in great detail and then of computing arithmetic means. These are precise and allow comparisons to be made from store-group to store-group. It did, however, supply the frequencies for the different elements of expense, for sales, turnover, depreciation, discounts, fixtures, outstanding accounts, returned goods, sales per square foot of floor space, etc., for 1919, or for another appropriate year, and called attention repeatedly to the fact that averages should be interpreted in terms of the number of instances used and in conformity with the peculiarities exhibited in the frequency tables.

Attention is also called to the fact that more identical stores are shown for the three years 1914, 1918, and 1919 than for 1914 alone. The reason for this would have been patent to the reviewer had he observed the plan under which the data are presented. For each of the three years for the identical stores it was necessary, as the data are presented, for each store to report only sales and rent, while for the single year, 1914, it was necessary that sales, rent, and total expense be reported. The use of a different number of stores in the various presentations is typical of the method followed throughout the study. The reason for doing this is referred to by the reviewer in another connection and should have been evident to him in this case.

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[1] The discussion on pages 167, 192–193, 203–204, 215, 263, 314–315, 388–389, 467, 469–470, 478, 523, 533–34—selecting only a few places where attention is given to this topic—is sufficient to indicate the care that is used to caution the reader not to use averages without the supporting data to which they apply.

In brief, the reviewer, while describing in a general way the contents of the Bureau's study, forgets the purpose of the study and takes little note of the methods which have been used to realize it. Because of the fact that statistical data are always susceptible to misuse, that they may appear to be exact and at the same time be full of error, and that many people are credulous to a fault in the use of them, the Bureau took special precaution to guard against its findings being improperly used. If its efforts in this respect have been almost completely overlooked by the reviewer, it can only hope that such will not be the case on the part of others into whose hands the volumes come.

HORACE SECRIST

The Bureau of Business Research,
Northwestern University, School of Commerce

## A REPLY

### BY H. K. HERWITZ

On the essential points Professor Secrist and I do not differ. The arithmetic mean is easy to find and easy to compute. Modes and medians are not. As Professor Secrist knows, however, and as the illustrations that I take from his study clearly show, the arithmetic mean, although it is easy to calculate or even because it is easy to compute, frequently does not show what it professes to show. This is my point. And it still seems to me true that matters of this kind should not be left to the scrutiny of ordinary readers of books of this sort, who usually are so little practiced in the art of statistics.

With regard to Professor Secrist's second point that the "detailed" tables would have yielded different results than the "total" tables, I can only add that an examination of the "detailed" tables does not confirm Professor Secrist's statement.

## MISCELLANEOUS NOTES

**Vital Statistics Courses.** The following information on vital statistics education in schools of public health was collected by the Committee on Vital Statistics of the American Statistical Association:

University of Chicago. Department of Hygiene and Bacteriology
Vital statistics and epidemiology. Professor E. O. Jordan.

Harvard University. School of Public Health.
An elementary course of lectures and laboratory work designed to familiarize the student with descriptive vital statistics, with graphic representation and with the basic theory of probabilities and correlation. Edwin B. Wilson, Professor of Vital Statistics.

Johns Hopkins University. School of Hygiene and Public Health.

Several courses designed to meet the needs of persons training for public health work and for students intending to specialize in statistical work as teachers, investigators, or administrators.

(a) Introduction to Vital Statistics

Methods of collecting, tabulating, adjusting and interpreting statistical data regarding human life, and review of chief statistical results of the past in this field.

(b) Laboratory Work in Vital Statistics

(c) Advanced Statistical Theory

Methods of statistical analysis. Curve fitting. Graduation of data. Life tables. Correlation.

(d) Colloquium on Practical Vital Statistics

Training in critical application of vital statistics to specific problems in biology, medicine and hygiene.

(e) Statistical Measurement of Public Health Activities

(f) Investigations in Biometry and Vital Statistics

(g) Special Investigations

Research on tuberculosis, hospital problems, etc.

Courses under the direction of Professor Raymond Pearl, assisted by a staff of seven associates.

University of Michigan. Graduate School

Vital Statistics (one hour, second semester); elementary methods in statistics; mathematical theory of statistics (a—introductory, b—advanced). Professor James W. Glover, and others.

Ohio State University. Graduate School

Demography. Open to students majoring in public health. Covers vital, social and sanitary statistics.

Social statistics. Application of statistical methods to social research. Miss Mark.

University of Pennsylvania. School of Hygiene and Public Health.

Social and vital statistics. Statistical principles connected with collection, presentation and interpretation of numerical facts, graphic methods, statistical control of public health work. Professor Robert Riegel.

Yale University. Department of Public Health.

Principles of vital statistics. Descriptive and analytic aspects of vital statistics. Life tables. Graphics. Assigned statistical problems in public health. Dr. L. I. Dublin.

**New Employment Statistics.** Arrangements have been made for securing monthly reports from a large list of manufacturing establishments in Massachusetts, showing numbers employed and total earnings, together with certain incidental information bearing on these two questions. The first canvass was undertaken during the month of September, 1922, and the results were highly satisfactory. In this work the State Department will coöperate with the United States Bureau of Labor Statistics and thereby avoid duplication in the collection of reports of this character. The information will be obtained in the first instance by this department, and copies of the reports will be furnished to the Federal Bureau for its use, in connection with similar data for other states, in compiling a report for the entire country. These monthly reports when compiled should serve as an important industrial barometer, showing the trend of employment and earnings of employees in the manufacturing industries.

**Harvard Business Review.** The Graduate School of Business Administration of Harvard University announces the publication, beginning in October, of the *Harvard Business Review*, a quarterly devoted to the theory and practice of business. The first number includes articles by Dean W. B. Donham, O. M. W. Sprague, Arthur S. Dewing, and other members of the faculty of the Graduate School, with contributions by business men such as George O. May, Frederic H. Curtis, and Julius Klein. The leading articles of the *Review* will be edited by an editorial committee of the faculty; the departments of business cases and book reviews will be in charge of a student editorial board.

**Publications of the International Congresses of Eugenics.** The First International Congress of Eugenics was held in London in 1912. The papers presented before this Congress are reported in two volumes entitled "Problems in Eugenics." There is also a supplementary pamphlet entitled "Catalog of Exhibits." American libraries can secure these reports directly from the Secretary-Treasurer of the Eugenics Research Association, Cold Spring Harbor, Long Island, N. Y.

The papers and reports of the Second International Congress of Eugenics, which was held at the American Museum of Natural History in New York in 1921, are now being printed by the Williams & Wilkins Company, Mount Royal & Guilford Avenues, Baltimore, Md. Volume I will be entitled "Eugenics, Genetics and The Family"; Volume II, "Eugenics in Race and State." Orders may be placed directly with the Williams & Wilkins Company for all publications of the Second Congress.

Besides these two volumes of scientific papers, there will be issued a supplementary pamphlet which will contain an account of the Congress, together with a Catalog of the Exhibits. Plans are in preparation for rebinding, under one cover, all accounts and descriptions of the exhibits.

The Pollak Foundation for Economic Research announces the publication of *The Making of Index Numbers: A Study of their Varieties, Tests, and Reliability*, by Professor Irving Fisher. This volume is a development of studies which were advocated and outlined by Professor Fisher at the meeting of the Statistical Association at Atlantic City, in December, 1920. Some of the preliminary findings were presented in the March, 1921, number of this JOURNAL. A special price will be made to members of the Association who send in advance orders.

The publication of Tables of $\sqrt{1-r^2}$ and $1-r^2$, by John Rice Miner, for use in partial correlation and in trigonometry, is announced by the Johns Hopkins Press.

Tables for Applied Mathematics to Finance, Insurance, and Statistics, edited by Professor James W. Glover, are now ready for delivery by George Wahr, Publisher (Ann Arbor, Mich.). These tables contain compound interest functions and logarithms of compound interest functions; life insurance and disability insurance functions; probability and statistical functions; and seven place logarithms of numbers from 1 to 100,000.

**Annual Meeting of the American Statistical Association.** The opening session of the Annual Meeting, to be held at Chicago, December 27–29, will be a joint meeting with the American Economic Association, on Wednesday afternoon, December 27. The general topic will be "The Outlook for 1923." Experts will discuss the level of prices and the cost of living, the trends in interest rates and investment, and wages and regularity of employment. Both the Economic Association and the Sociological Society will join with us in an evening session to hear the presidential addresses of the three associations. On Thursday, December 28, our Association will hold three sessions. The morning topic will be "Population Facts and the Malthusian Law." In the afternoon a round table will discuss "Standards and Methods of Statistical Instruction and Training." At this session the proposed plan, described in more detail elsewhere in this issue, for a series of standard reference books on statistical methods and practice will be presented for consideration by the Association. In the evening the Hon. Herbert C. Hoover, Secretary of Commerce, will deliver an address. Mr. Hoover presides over the most important statistical activities of the federal Government and is now carrying forward an active program for closer coöperation between the government and private business. The Association is fortunate in securing his presence at this most representative gathering of statisticians and economists. On Friday morning, December 29, a session will be devoted to "Employment Statistics and Allied Topics." The Association has had an active committee at work on this problem during the year, in coöperation with other agencies concerned, and important contributions by experts may be expected.

ROBERT E. CHADDOCK,
*Secretary*

Dr. Jacques Bertillon, who died at Paris on July 7 last, was one of the most eminent of the French demographers and was known as the father of International Nosologic Nomenclature. In 1893 he presented at the meeting of the International Statistical Institute, held at Chicago, a draft of a system devised by him and intended for international use as a standard for the statistical classification of causes of sickness and death. Such was the inception of what was known for awhile as the Bertillon Classification, but which by reason of its adoption by most of the countries of the civilized world has become the International List of Causes of Sickness and Death.

Prior to the adoption of the present system there was absolutely no international standard of nosological practice. Causes of death were classified by the several countries, and even by important political units within most countries, according to different systems. Obviously, the results were not comparable with each other. Dr. Bertillon's system of classification provided for the grouping under one title-heading of all causes of death reported in the same or in synonymous terms. He stipulated that by periodical revision his system was to be kept in conformity with the advancement of medical science. In consequence, there were held at Paris in 1900, 1909, and 1920 meetings of the Decennial Conference for the Revision of the International Nosologic Nomenclature. With each of these Conferences the number of countries participating has increased, and as a result we have now in effect for the third decade a system which has given to the world comparable international mortality statistics.

It is of the utmost importance to the advancement of sanitary science that statistics of causes of death published by different offices be comparable with each other. There can be no doubt that Dr. Bertillon hastened by many years the uniformity of practice which resulted in the compilation of such statistics.

Dr. Jacques Bertillon was born in 1851 and was one of a distinguished family. He was the grandson of Dr. Achille Guillard, who was eminent both as a botanist and as a statistician. He was the son of Louis Alphonse Bertillon, a noted French statistician, and a brother of Alphonse Bertillon who invented the Bertillon System of Body Measurements for the use of criminal investigation bureaus. Dr. Bertillon served for twenty years as Secretary-General of the Commission for the Revision of the International Nosologic Nomenclature. For many years he was Director of the Paris Bureau of Statistics; he was a Chevalier of the Legion of Honor and an author of note. His works relate chiefly to the depopulation of France, the relation of marriage to longevity, and the effects of alcoholism on health and morals.

Dr. E. H. Downey, workmen's compensation insurance expert, was drowned at Avalon, N. J., July 9, 1922. During the past seven years Dr. Downey had been connected with the Department of Insurance of Pennsylvania, and he was widely known as a deep and thorough student of compensation insurance.

Dr. Downey was born in Iowa in 1879. He was graduated from Iowa State University, and later received his doctor's degree in economics from the University of Wisconsin. In connection with his university researches and his work with the Wisconsin Industrial Commission and the Insurance Department of Pennsylvania he published some very valuable monographs and scientific articles on accident compensation. Members of the American social science organizations will remember his very able address on workmen's compensation at the Annual Meetings in Pittsburgh last year. But Dr. Downey's greatest contribution was his untiring and intelligent activity in workmen's compensation administration. His untimely death is a very serious loss in the scientific development of legislation and administration in a field which yearly becomes increasingly complex.

Mr. Walter W. Stewart, Professor of Economics at Amherst College, has been appointed Director of the Division of Research and Analysis of the Federal Reserve Board. He takes the place of Dr. H. Parker Willis who recently resigned.

During the summer, prior to his acceptance of the position with the Federal Reserve Board, Dr. Stewart was engaged under the auspices of the Committee of the Plan of New York and Its Environs in the preparation of a preliminary plan and outline of economic portions of the investigations to be made in connection with the development of the proposed plan for Metropolitan New York.

Dr. W. A. Berridge, after two years as Instructor and Tutor in Economics at Harvard, has been appointed Assistant Professor of Economics at Brown. Dr.

Berridge has recently returned from England, where he has been collecting unpublished materials on the business cycle and on unemployment.

Dr. Rainard B. Robbins has returned to the University of Michigan as Assistant Professor of Mathematics after an absence of two years, during which time he was employed as Assistant Actuary in the New York Department of Insurance at Albany.

Mr. Arthur E. Albrecht, Instructor in Economics at the College of the City of New York, has been appointed to the position of economist in the New York City office of the State Department of Farms and Markets.

Mr. J. E. Vesely, formerly with the Wieboldt Company of Chicago, is now Statistician for the United States Gypsum Company.

Mr. Charles H. Wickens has been appointed Commonwealth Statistician of Australia to succeed G. H. Knibbs, C.M.G., who has become Director of the Commonwealth Institute of Science and Industry. Mr. Wickens has been one of the senior officers of the Bureau of Census and Statistics since its organization in 1906.

Professor Umberto Ricci has resigned as Chief of the Bureau of Statistics of the International Institute of Agriculture. The Institute's *Year Book of Agricultural Statistics* has been issued under the direction of Professor Ricci.

## MEMBERS ELECTED SINCE AUGUST

Boudo, Carolyn, State Health Department, Albany, N. Y.
Cherington, Paul T., J. Walter Thompson Co., 244 Madison Ave., New York City
Fach, Herbert T., Rockefeller Foundation, 61 Broadway, New York City
Goldstein, Maurice L., Statistical Bureau, Metropolitan Life Ins. Co., New York City
Hoover, Herbert C., Secretary of Commerce, Washington, D. C.
Klein, Henry J., Statistical Bureau, Metropolitan Life Ins. Co., New York City
Lincoln, Edmond E., Western Electric Co., 195 Broadway, New York City
Lister, W. E., Actuary, Royal Indemnity Co., New York City
Richardson, I. G., Atlas Portland Cement Co., New York City
Roorbach, George B., Harvard University, Cambridge, Mass.
Schoenfeld, Wm. A., Marketing Research, Bureau of Agricultural Economics, Dept. of Agriculture, Washington, D. C.
Seligman, Mrs. Eustace, 161 E. 79th St., New York City
Smith, James G., Dept. of Economics, Princeton University, Princeton, N. J.
Stark, M. P., Washburn Crosby Co., Chamber of Commerce, Minneapolis, Minn.
Sturgis, Arthur, Consulting Economist, 712 Southern Bldg., Washington, D. C.
Thomas, Dorothy, London School of Economics, London, England
Thompson, Warren S., Scripps Foundation, Miami University, Oxford, Ohio
Wachsman, Charles, Statistical Bureau, Metropolitan Life Ins. Co., New York City
Wembridge, Harry A., Joseph & Feiss Co., Cleveland, Ohio
Wiesner, Dorothy, National Tuberculosis Association, New York City
Worsley, W. J., Statistical Dept., Edison Lamp Works, Harrison, N. J.

# REVIEWS

*Increase of Population in the United States 1910–1920*, by William S. Rossiter. Bureau of the Census. 1922. 259 pp.

This publication, the first of a projected series of monographs upon various aspects of the census of 1920, is an attempt "to present a statistical picture of national progress," especially as mirrored in the changes of population and its various classes between 1910 and 1920. The statement of purpose suggests that the monograph might be compared with Tucker's *Progress of the United States in Population and Wealth in Fifty Years as Exhibited by the Decennial Census* (1843), a very able attempt by a private scholar to elucidate the results of the first six censuses which the government had printed with no effort at interpretation. It might also be compared with various chapters or sections in later census reports after some influence, possibly that of Professor Tucker, had led the officials, beginning with DeBow in 1850, to present the main results in words as well as figures. Among the publications of the latter class these may be mentioned:

In the Tenth Census: Population, Volume I—Walker and Gannett's "General Discussion of the Movements of Population 1790 to 1880," especially pages xi–xli.

In the Eleventh Census: Population, Part I—Porter, Gannett and Hunt's "Progress of the Nation 1790 to 1890."

In the Twelfth Census: Population, Volume I—Hunt's discussion of the "Statistics of Population," and in the Supplementary Analysis, various chapters by the writer and others.

In the Thirteenth Census: Several chapters introducing the tables dealing with the different topics.

One might go farther afield and compare this monograph and its successors with the introductory volumes in several foreign censuses. A careful study of the degree and way in which the census figures of population have been interpreted in different countries and at different dates by the office responsible for them would probably be worth while. But such a study would exceed the scope of a review and call for more space than is now available. Suffice it to say that the present monograph has been prepared in a manner somewhat different from its forerunners. Heretofore such writing has been done either by an outsider making no use of office resources (Tucker) or by a member of the staff. The writer of this analysis is one who won high position and reputation within the office and then withdrew to more inviting fields, but who did not end his intimate association with his former colleagues of the Census Bureau.

His work is a product of coöperation between an outside expert and the office which finds its only prototype in the manufactures census of 1900. It is the first fruit of a policy introduced in the census of 1920 at the suggestion of the Advisory

Committee of the American Statistical Association and the American Economic Association. It appeared that the mandate of Congress for the completion and publication of the preceding census within three years, a mandate without a sanction, had not been obeyed. Therefore the advisory committee urged that rapid production was after accuracy the most important duty and opportunity of the office, that to assure this result there should be no delay for the preparation of text other than what was needed to make the meaning of the figures clear, and that the Bureau should arrange for the publication later of special studies or monographs to aid in the interpretation of its figures. The first of these prepared by the chairman of the joint Advisory Committee is now given to the public.

With these explanations the following summary of some of its main points, with running comments or criticisms in the few cases where I differ, will stand in its proper perspective.

The population of the United States in 1920 exceeded that in 1910 by 13.74 million. To determine the number of new members of the population at the later date the monograph adds to this 13.74 million 11.24 million to balance the number of persons enumerated in 1910 who died between that year and 1920, and 2.28 million to balance the number who left the country in the same decade and were alive at its close.

To estimate the number who died, 1910–20, among those enumerated in the earlier year the office has applied the annual death rate of the registration area in 1910 to the population of the country in that year, the rate for the population above one year of age in the registration area in 1911 to the survivors throughout the country in that year, and so on. One of the assumptions underlying this method, namely, that the death rates in the registration area give the closest approximation available to the death rates in the country, is quite far from the truth. For the proportions of the sexes and ages in the population of the registration area may be different from those in the population of the United States, and the proportions of the two main races certainly are different. Thus the present method assumes a death rate of 14.958 per 1,000 in the population of the United States in 1910 because that was the rate in the registration area. But the death rate of whites in the registration area (14.573 per 1,000) applied to the whites in the country yields 1,191,080 deaths, and the death rate of colored in the registration area (24.202 per 1,000) applied to the colored in the country yields 247,836 deaths, a total of 1,438,916 estimated deaths in the country, indicating a rate of 15.645 instead of 14.958 per 1,000 for the entire country in 1910. In other words, after a correction for race it appears that the death rate proper to use exceeds that employed by 0.687 per 1,000 or 4.59 per cent. With this correction the estimated number of deaths in the decade is raised by 516,000, and the population in 1920, estimated by adding to the survivors of those enumerated in 1910 all natives under 9 and 17/24 years (the interval between the censuses of 1910 and 1920), and the survivors of all immigrants becomes 105,400,000 instead of 105,920,000. The result is of importance because the figures in the monograph point toward omissions of 210,000 in the census of 1920, while my substituted figures suggest that the enumeration of 1920 found 310,000 more people than would have been expected.

The rate of decennial increase in the population of the United States has been falling since 1860, but the regularity of this change is obscured by omissions undoubted and serious at the census of 1870 and probable though smaller in amount at that of 1890. The rates of decennial increase since 1900 after correcting for the fact that the enumerations were not quite ten years apart were 21.3 per cent between 1900 and 1910, and 15.4 per cent between 1910 and 1920, so that the rate in the later decade was less than three-fourths of that in the earlier.

This checking of the growth of population affected the great divisions of the country very differently. If we neglect for a moment the far West, that is, the mountain and Pacific divisions, and consider only the North and South, it appears that between 1900 and 1910 the South increased about one-seventh faster than the North, but between 1910 and 1920 the North increased about one-fifth faster than the South. In the earlier of these two decades the states west of the Mississippi increased seven-tenths faster than those east of it, but in the later they increased only one-seventh faster. To present the changes in a somewhat different way, the states of the mountain and Pacific divisions increased in the second decade of the country less than half as fast as in the first, the southern states increased about two-thirds as fast, and the northern states increased four-fifths as fast. This closer approach to the earlier rate of growth in the northern states with a high proportion of urban population suggests, what other figures establish, that the cities have retained their former rates of growth more nearly than the rural districts have. In fact, the increase of American cities in 1910–20 was at a rate nearly three-fourths of that in the preceding decade; the increase in the rural districts fell to less than one-half of the rate ten years earlier.

May I here repeat a suggestion of many years ago that the census definition of an urban district or city, namely, an incorporated place containing at least 2,500 inhabitants, is provisional and temporary. The main distinction between city and country, I take it, is that in the country more food and in the city less food is produced than is needed to support the people who live within the area. If this be so, the line of separation should be based not on total population but on density. For example, there is no good ground in my opinion, except the fact that we lack a practicable and better definition, for calling Ithaca in Tompkins County, New York, a city and Groton in the same county rural because the former has 17,000 people and the latter only 2,235. For the average density of population in Groton is 3,788 and in Ithaca 3,721 persons to a square mile. Perhaps in future decades, when the area and population of all small divisions of the United States have been measured, we shall define rural districts as those with so low a density of population that they produce more food than they consume, and cities as those districts with so high a density of population that they consume more food than they produce. An intermediate class, composed of districts where both agriculture and other occupations are important sources of a livelihood, may be necessary.

In comparing the growth of city and country one may define the urban population of 1910 or 1920 as the population of all incorporated places which then had at least 2,500 inhabitants, ignoring the fact that several hundred places had less than that population in 1910 but more in 1920. Or one may treat as urban at both censuses those places and those only which in 1920 (or 1910) had at least 2,500 inhabitants. Under the former method American cities grew, 1910–20, nine times as fast as country districts; under the latter and more accurate method they grew less than five times as fast. This second method, however, is not above criticism, for it rests on the assumption that the boundaries of all cities were the same in 1920 as in 1910, although one may feel sure that a significant number annexed territory during the decade and thus swelled their real increase. Under the method of a diminishing rural area the gain in the rural districts, 1900–10, was more than one-fourth, and 1910–20, little more than one-ninth of the increase in the country as a whole. If the large group of northern states from Maine to North Dakota and south to Mason and Dixon's line, the Ohio, and the southern boundary of Missouri and Kansas be regarded as a unit, the number of persons living outside of incorporated places with at least 2,500 inhabitants was about 175,000 less in 1920 than in 1910.

The excess of males which had been noted in the United States for a century rose slowly from 1820 to 1860 when it was nearly three quarters of a million, fell in the following decade by 300,000 as a result of the Civil War and the concurrent check to immigration, then rose for forty years until in 1910 it was about 2,700,000. But in the last decade of war and slackened immigration it fell again by 600,000. In 1920 the excess of males was still above 2,000,000 and greater in amount than at any date before 1910. But the ratio of excess was less than in 1890 or 1900.

About age little is said directly in the monograph, and occasionally the writer seems not to allow enough for changes in age composition. Thus, he tries to explain the larger proportion of widows in 1920 as compared with New Hampshire figures of 1773 by supposing that before the Revolution "the marital relationship was held to be more desirable" and that it was then more difficult for widows to support themselves (page 147). Although these were probably factors I suspect that an influence at least equally powerful may be found in the fact that the average age of the population in 1920 was fully ten years greater than in 1773, and that widowhood being a function of age naturally increased with it.

Mr. Rossiter suggests that the extinction of the North American Indian (sc. in the United States) "has been averted by increasing intermarriage" (page 137). Does not this depend upon the definition of extinction? Few would offer evidence to show that the amount of Indian blood in our population has diminished. But it may be true, nevertheless, that the number of persons with obvious Indian characteristics is decreasing, and intermarriage would not avert but rather contribute to that kind of extinction. Or if one means by an Indian a person living in tribal relations under Indian law and custom, the evidence for approaching extinction is even more convincing.

Notwithstanding these few points at which I am disposed to take issue with the writer's conclusions, or rather with the office methods or practice upon which he stands, the monograph as a whole commends itself as careful, thorough, discriminating, and above all, readable and significant. It will arouse a new and wider interest in the meaning of census figures and of the changes in population which they mirror and reveal.

We may admit for it and hope for its successors that the policy exemplified by the series, as the Director claims in his prefatory note, "is clearly a long step in advance in the effort to make the decennial census of as much practical value to the Nation as possible" (page 7) and yet ask whether this effort goes more than half way toward the ideal. The Bureau of the Census ought to be the best place in the United States for the training of statisticians. A forceful and competent director, interested in securing that result, who had a reasonably permanent tenure and who was able to get backing from Congress, might make it so. In the twenty years of its life as a permanent office the Bureau has had directors of various types, but none, I believe, who has made this a real part of his job. Until his work is more nearly divorced from politics or until the assistant director becomes the permanent and recognized head of the scientific personnel and the director's chief of staff in all matters scientific or professional, the organization of the Bureau of the Census on the scientific side will continue to be seriously defective. Work like that I tried to do in 1900 and like Mr. Rossiter and his followers are doing in this series may salve the defect for an emergency; they cannot really cure it.

WALTER F. WILLCOX

Cornell University

*Wages and Hours in Anthracite Mining.* National Industrial Conference Board, Research Report Number 47. New York: The Century Co. 1922. 67 pp.

This report is compiled from questionnaires submitted to 47 per cent of the operating anthracite mining companies. It covers about 60 per cent of the employees in the anthracite mining industry. Women workers, boys, foremen, salaried and clerical workers are excluded from the report. Moreover, all employees who did not work within two days of the full time offered by the employers in the semi-monthly periods studied were excluded from the report. This was done because the mining companies contend that to include all wage-earners irrespective of the time worked "would give a distorted picture," since miners frequently shift from mine to mine or from job to job within the same mine. This turnover increases the total number on the payroll in any given period and lowers the apparent average earnings. The report itself recognizes the weakness of this procedure, for it says:

> Obviously, the comprehensive way of dealing with the wages and hours of work situation in the anthracite mining industry would be to secure and analyze pertinent data for all mine workers, properly classified according to the number of days and hours worked in each pay period, and to give each group its proper weight in the final determination of the average conditions in the industry in respect to wage earnings and working time. This would also permit of definite evaluation in comprehensive and scientific manner of such peculiarities of labor turnover and payroll records as are claimed to exist in the industry. . . . In presenting the results of its investigation the Board therefore reserves judgment as to their adequacy in representing general wage-earning conditions in the industry until more evidence is available regarding the effects of excluding the shifting or part-time workers.

Nevertheless it is argued (p. 9) that the study "affords a fair picture of wage-earning conditions in the industry."

The schedules compiled were for the last half of each of the following months: June, 1914; October, 1920; March, 1921; June, 1921; and October, 1921. Taking June, 1914, as the base, average hourly earnings of all wage-earners covered except contract miners had risen to the index number of 266 by October, 1921; for contract miners, to 258. Semi-monthly earnings for all workers (contract miners excluded) had risen to 258 by October, 1921; for contract miners, to 243. The average weekly hours worked by all wage-earners (contract miners excluded) decreased from 51.6 hours in June, 1914, to 48.2 hours in October, 1921; for contract miners, from 42.4 hours to 39.9 hours.

These figures challenge one's attention. The award of the Anthracite Coal Commission in August, 1920, granted an increase in the gross tonnage rate for contract miners of 65 per cent over the 1916 rate. Since the 1916 rate was 7 per cent over the rate obtaining in June, 1914, the base period used by the Board, the tonnage rate for October, 1921, would be 76.5 per cent higher than the rate obtaining in June, 1914.[1] Yet the Board finds that the hourly earnings of contract miners had increased 158 per cent and the semi-monthly earnings 143 per cent. It is true that changes in the tonnage rates do not accurately represent changes in earnings because deductions for helpers and supplies have not changed in the same proportion.

The Board finds that the earnings of contract miners in June, 1914, averaged 41 cents an hour. The Board assumes that in 1914 contract miners worked on the average 8 hours per start or day (p. 12). This would make the daily earnings $3.28 for June, 1914. Compare this with the 1914 daily wage of $5.26 for contract miners as given in a table compiled from wage agreements and a memorandum submitted to the Conference of National Labor Adjusting Agencies of November, 1918.[2] On the other hand we find that the semi-monthly earnings of contract miners for October, 1921, as given by the Board were $91.37, while the Bureau of Labor Statistics finds that the semi-monthly earnings for January, 1922, were $86.60.[3] Considering the difference in periods as well as firms covered there appears here to be substantial agreement.

Turning now from the contract miners to the rest of the wage-earners we find a fairly close correspondence between the data presented by the Board and other available data. The following table compares the hourly rates compiled from the wage agreements and the memorandum submitted to the Conference of National Labor Adjusting Agencies with the hourly earnings given by the Board. The Board's figures are for June, 1914, while the memorandum figures are for 1914.

| | N. I. C. Board | Memorandum |
|---|---|---|
| Skilled labor (outside) | .265 | .277–.303 |
| Common labor (outside) | .183 | .169–.203 |
| Common labor (inside) | .220 | .225–.251 |
| Skilled labor (inside) | .275 | .277–.303 (company miners) |

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[1] *Bulletin of the U. S. Bureau of Labor Statistics*, No. 279, p. 12.

[2] *Wages in Various Industries and Occupations*, Bureau of Applied Economics, Bulletin No. 8, p. 6. Mr. Ash's estimate, however, made in the *Labor Review* for October, 1920 (p. 104), corresponds much more closely with the Board's figures.

[3] *Monthly Labor Review*, May, 1922.

For the post-war period we find that the Board's figure for hourly earnings of skilled inside labor for October, 1921, is 0.677, while the data furnished by the Bureau of Labor Statistics for January, 1922, give 0.686 as the hourly earnings.[1] For common inside labor the Board's figure for October is 0.596, while the Bureau's data for January, 1922, give the hourly earnings as 0.599.[2] The semi-monthly earnings of skilled labor as shown by the Board were 9.5 per cent higher than the semi-monthly earnings shown by the Bureau. This is due to the fact that the average hours actually worked were considerably higher as shown by the Board than as shown by the Bureau. In the case of common labor the hours worked were about the same in the two studies, and therefore since the hourly earnings were similar the semi-monthly earnings were likewise similar.

The wage increases of contract miners especially (contract miners constitute about 30 per cent of all anthracite wage-earners) as shown in this report appear to be somewhat greater than other available data would indicate. This may be partly due to the questionnaire method which has been criticized by Mr. Douglas in previous issues of this JOURNAL. In part it may be due to the fact that the base period used by the Board (June, 1914) was far from normal, as the present reviewer has elsewhere attempted to show.[3] Although a study of wage rates would not be affected much by using such a base, a study of earnings using an abnormal period for a base would present a distorted picture. Again, it does not appear quite fair to compare the wages from October, 1920, to October, 1921, with those for June, 1914, without showing the earnings in the intervening period. The great increase in anthracite wages came in 1920. The earnings of anthracite labor in 1920 and 1921 were far more favorable than those of earlier years, particularly the years prior to 1918.

ALVIN H. HANSEN

University of Minnesota

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*Report on Productive Industries, Railways, Taxes and Assessments, Waterways, and Miscellaneous Statistics of the Commonwealth of Pennsylvania for the Year 1920.* Department of Internal Affairs. Compiled by the Bureau of Statistics and Information, M. Hoke Gottschall, Director, Harrisburg, Pa.: J. L. L. Kuhn, Printer to the Commonwealth. 1921. 1,040 pp.

In a "foreword" to this report the Secretary of Internal Affairs, James F. Woodward, makes the following statement in the opening paragraph:

> In the year 1872 the first official report on industrial statistics for the Commonwealth of Pennsylvania was issued by the "Commissioner of Statistics" and the presentation of this report covering the year 1920, therefore, becomes the 48th Annual Report of the Bureau of Statistics and Information. The records of the Department of Internal Affairs show a complete set of these Annual Reports and they portray a marvelous development of industry in Pennsylvania.

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[1] *Monthly Labor Review*, May, 1922. The above figure for skilled labor was obtained by taking a weighted average of the hourly earnings of blacksmiths, bratticemen, machinists, masons, company miners, timbermen, and trackmen as given by the Bureau.

[2] For common labor a weighted average of the hourly earnings of cagers, car-runners, drivers, and laborers was calculated.

[3] "The Buying Power of Labor During the War," this JOURNAL, March, 1922.

As indicated by its title, the report is of wide scope, relating, as it does, not only to the industrial activities of the Commonwealth, but also including "miscellaneous statistics reflecting activities of the various departments of the Commonwealth for the year 1920." Virtually, therefore, it fulfils a two-fold purpose—that of recording the progress of the industries of the Commonwealth, and that of serving as a statistical abstract of Pennsylvania, analagous, in general plan, to the Statistical Abstract of the United States. Thus in a single volume are brought together the principal statistical data relative to the Commonwealth, rendering it unnecessary for one to consult numerous official reports in order to gain a general knowledge of the resources and development of the state. In connection with each statistical table, not obtained from *original* sources by the Department of Internal Affairs, due acknowledgment is made of the "secondary source" from which the data were obtained.

Aside from the brief foreword (3 pages) and a few paragraphs accompanying several of the miscellaneous tables, the entire report consists of statistical tables. It is to be regretted that the report did not include a description of the methods employed by the Bureau of Statistics and Information in securing data from original sources, and at least a few pages of interpretative text, with a discussion of the more significant results of its inquiries. Prior to the issuance of the report, summaries, in text form, of the principal facts with reference to the industrial activities of the Commonwealth were issued as "press releases," which, if they had been incorporated as an introduction to the report, would have added materially to its interest, at least to many persons who have little, if any, interest in a mere collection of statistical tables. In the foreword, it is true, allusion is made to "the more than 5,000,000 separate tabulations herewith presented," but the reader is left in disquieting doubt as to what is meant by a "tabulation," as the number of separate tables can be expressed with not more than two digits, and even of separate totals a rough estimate does not reach to a half-million.

Because of the fact that the report consists almost wholly of tabular matter, a critical review must confine itself primarily to the form and arrangement of the tables. These conform to accepted practice in official publications, except that the titles are not sufficiently explicit to indicate adequately the nature of the data presented therein. This criticism is particularly true of the tables of "industrial statistics" constituting Parts I, II, and III of the report and comprising over 600 pages. Only by an examination of the box headings can one determine that the data in these tables relate to "industries," and even then only after reading through several pages of side headings does one become aware that the data do not relate wholly to manufacturing industries but include also building and contracting, mines and quarries, and public service. Part III, entitled "Detail Industrial Tabulation for 1920 by Counties and Selected Municipalities," consists of two tables of similar form, together occupying 545 pages. As no continued titles or page headings are given, the first page of the second table, which has reference to municipalities, cannot be readily located. The table of contents might be of service in assisting one to locate the various tables in the report were it more detailed, but it is merely a list of the titles of the nine "Parts" of the report and does not even include references to the initial pages of the respective parts. A complete list of the tables with page references would enable the reader to turn to any table without difficulty. Usually in voluminous governmental reports consisting principally of tabular matter (as, for example, the United States census reports) a table of contents and a list of tables, both with initial page references, appear immediately or closely following the title page.

There is an index to the report of which no mention is made in the foreword or table of contents, so-called. For one not already familiar with the subject-matter of the report the index does not serve adequately as a reference guide to particular tables. For example, there is among the large number of miscellaneous tables one entitled "Number of arrivals and departures of vessels," but there does not appear to be any reference whatever in the index to "vessels," "arrivals," or "departures," nor any means of locating this table other than by laboriously turning the pages until page 898 is reached.

No opinion as to the accuracy of the data presented in the report would be justified unless the critic had first inquired into the methods employed in the collection of information from the original sources, and in editing and tabulating the returns; but a close examination of certain of the tables leads to some question as to whether or not requisite care was observed in editing the report. By way of illustration: In the first table in the report, which bears the title "State Summary," industrial statistics for the several years 1916, 1917, 1918, 1919, and 1920, are presented in parallel columns and, presumably, these data are strictly comparable; yet it appears that the "number of plants operated" in 1920 was 26,077, while in 1919 there were only 20,888, and that there was an increase, in a single year, of 5,189 plants operated, or nearly 25 per cent, which increase any one reasonably familiar with industrial conditions in Pennsylvania during these two years would immediately question. The explanation of this inordinate increase in the number of plants operated is found in the following statement which appeared in a press release issued by the Department on October 21, 1921.

> According to the preliminary figures announced by Secretary of Internal Affairs Woodward, there were 26,076 industrial establishments reporting to the Pennsylvania Department of Internal Affairs in 1920. In the preceding year there were 20,888, and included in the increase last year were numerous small plants which had never before been called upon to make reports and which affected the general production valuation total but little. Of course newly established plants were also included in the increase.

Evidently the press release was issued several months prior to the date on which the report was issued in print, as a "letter of transmittal" appearing in the report was dated December 1, 1921. There was, therefore, ample opportunity to include in the report (at least as a note to the table above referred to) a statement explanatory of the increase in the number of plants operated, to which plants the industrial statistics, comprising considerably more than one half of the report, relate.

Objection might be raised to the publication of data relative to wages paid, capital invested, and total value of products in round hundreds of dollars when the amounts are comparatively small. Numerous items and totals of less than $1,000 appear in the tables of industrial statistics. Readers of the report are entitled, at least, to know whether the tens and units were eliminated when the questionnaires from individual reporting agencies were edited or when the tables were assembled for printing, but the report furnishes no explanation as to the method employed.

In general it may be said that the report under review should prove to be a very useful contribution to the rapidly growing list of official statistical reports periodically issued. Other states which do not issue a compendium of information relative to their industries and resources might well follow the example of Pennsylvania in this respect. Hardly any other "medium for disseminating information the public should have" could prove more effective than a volume of this character.

Roswell F. Phelps

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*Wealth and Taxable Capacity*, by Sir Josiah Stamp. London: P. S. King & Son, Ltd. 1922. 195 pp.

Sir Josiah Stamp's new book contains the Newmarch Lectures for 1920–21, and represents an "attempt to outline some of the elementary principles involved in the valuation of national capital and income, and the determination of their distribution and their relation to prices, taxation, and public debt." There are six chapters, dealing respectively with the National Capital, the National Income, the Distribution of Income and Capital, the Limits of Taxable Capacity, the Effect of Changing Price Levels upon Profits and Wages, and the Effect of Changing Price Levels on the Burden of Public Debt. The book is short and, in the words of the author, "suffers from the defects of the lecture form." It is difficult reading at points; the author is forced in many places to state conclusions rather dogmatically and to forego explanations which would be particularly welcome to foreign readers. But the essential questions involved are dealt with in a most helpful way, and in many respects the book gains from its brevity. One sees the forest better because some of the trees are omitted or sketched in the most impressionistic way, and the limitations under which the lecturer spoke only serve to emphasize his unusual mental vigor and statistical ingenuity.

It is really an essay in financial arithmetic, rather than a statistical discussion of the ordinary kind. Most of the figures are approximations subject to wide margins of possible error. The treatment is beset at every hand with technical and theoretical difficulties, which can be bridged only by the exercise of great ingenuity. Difficult questions of ethics and political psychology are involved. Yet these questions must in some way be answered. Our financial leaders must have quantitative ideas about the taxable capacity of their own and other countries, particularly that of Germany. British leaders, at least, must reach some conclusion about the approximate yield of a capital levy, or a levy upon war-made wealth. We must somehow form a conclusion about the distribution of the national dividend and decide whether the trend of change is encouraging or discouraging, wholesome or the reverse. Taxpayers and taxgatherers are particularly concerned at the present time with the effect of changing price levels upon profits and the public debt; and the last two lectures are unusually valuable, not because they represent a rounded and final treatment of this subject, but because they break a path through a statistical wilderness which somehow must be explored and mapped. It is in questions of this kind that Sir Josiah Stamp's versatility and high-powered mind are most helpful.

The book is full of useful cautions pointing out the pitfalls that must be avoided in dealing with national wealth, national income, and taxable capacity. It is full also of important conclusions, such as the finding "that the ordinary person of today is four times as well off in real commodities as the person in the corresponding stage in the scale in the beginning of the nineteenth century"; or that if all the incomes over £250 per annum were pooled and divided, it would add an amount of approximately five shillings a week, or perhaps a little more, to each British family. The conclusions relating to the effect of change in price levels upon profits are unusually suggestive. The author concludes that for short periods the fluctuation in profits may be roughly taken at two-thirds to three-fourths of the corresponding fluctuations in turnover, as represented by banking and foreign trade statistics, which reflect both quantities and prices. In coal mining a change in price represented by one point was found to be accompanied, on the average, by a change in profits of approximately three points. In the case of merchants' profits, however, "the fluctuations in total profits were almost entirely those due to the amount of sales and the results were unaffected by price changes."

These statistical results are supplemented by a theoretical examination of the relation between price changes and profits, from which the following equation is deduced: $\text{Profit} = \frac{1}{R} T\ P_2 + S(P_2 - P_1)$, in which $R$ is the rate of profit, $T$ the turnover, $P_1$ and $P_2$ the two levels of prices, and $S$ the stock. The inference from this equation and the general analysis on which it is based would seem to be that total profits or losses in any year are equal to the change in price multiplied by the average stock carried, plus the normal profit on sales. This conclusion corresponds with American experience that in times of rapid price changes one of the most important elements of profits is the increase or decrease in the value of stocks on hand. But it is in apparent conflict with the statistical finding regarding merchants' profits, where the fluctuations were found to vary almost entirely with the amount of sales. The author at this point, however, is particularly occupied in driving home the useful truth that because of the vital connection between stocks, price changes, and profits, it is essential that deflation shall take place gradually, so that shrinkage in the value of stocks may represent merely "a reduction and not a total cancellation of the ordinary profits."

Statistical studies of the kind discussed in these lectures are not only helpful, they are absolutely necessary to the formulation of any sound financial or political program. But when one considers the estimates which must be made, and the psychological or political factors which must be allowed for although they cannot be measured statistically, the conclusion is borne in upon the reader that they are more practical than scientific. For instance, the computation of national wealth is arrived at by capitalizing statistics of income. The latter themselves are faulty and must be corrected in highly important ways. When this has been done the appropriate rates of capitalization must be applied. Anyone who is familiar with the essential uncertainty attaching to the proper rates of capitalization and the extent to which they vary, not only from industry to industry but for particular business units within each industry, must doubt the scientific significance of the aggregate. One may—indeed, one must—figure on changes in this aggregate for certain purposes; but the reviewer, at least, would be much better satisfied if we confined the statistics to measurements of change and called the base, or starting point, $x$.

The difficulties and, to a certain extent, the unreality of these huge aggregates are well illustrated by W. I. King's criticism [1] of Stamp's treatment of interest. Stamp suggests that interest upon war debt should be deducted from the national income (based upon taxable income) because unless we do this "the bigger the debt, the bigger the income." King replies that "the author apparently overlooks the fact that the borrower, by obtaining goods when he wishes them, may thereby gain an additional service equalling in value the interest that he pays. Is it not reasonable to include the value of this additional service in the total of the national income?" King classifies the victory over Germany, or the costs thereof, along with payments for groceries and theater tickets, as a consumptive expenditure. He not only does that but he suggests that the service for which we pay interest is a real service which should be included in the national income *when the interest payment is made*. If, as a people, we borrow for purposes of consumption today, the interest which our children must pay for our fun really increases the national income. The greater our extravagance in this generation and the deeper in debt we go because of it, the larger the money income of the next generation will be.

It seems absurd: but the absurdity is not Dr. King's or Sir Josiah Stamp's. Both are in essential respects right. Waiting is a service; interest is the payment for waiting; and our usual economic definition of income includes service. But the concept of income which includes this kind of service and excludes the thousands of services which happen not to be measured in money or the equivalent of money is essentially misleading. I should add that Dr. Stamp recognizes the logical flaws inherent in the usually accepted definition of national income.

T. S. Adams

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*Statistical Year Book of the Kingdom of Siam.* 1921.

This is a most extraordinary statistical publication and reflects the profound influence of British administrative methods on alien forms of government in the direction of progress and civilization. The *Year Book* is published by the Department of General Statistics, Ministry of Finance, in an English edition dated December, 1921. Its main divisions consider: (1) meteorology; (2) population; (3) finance; (4) foreign trade and commerce; (5) posts, telegraphs and telephones; (6) state railways; (7) education; (8) justice; (9) agriculture; (10) opium; (11) mining; (12) prices; (13) cultivated areas under rice; and (14) weights and measures. In other words, the *Year Book* reveals the state of the Siamese nation in all its essentials as required for legislative and general purposes. The presentation of the facts is made with admirable clearness and due consideration of scientific requirements.

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[1] *American Economic Review*, Sept., 1922, p. 532.

The census figures are for the year 1911–12, but a calculation is included of the population for intercensal years from 1901 to 1921, the figure being now placed at 9,121,000. The density of population is 17 per square kilometer, varying from 5 for one district to 214 for another. The sex distribution for the year 1911–12 reveals 4,122,168 males and 4,144,240 females, or a total of 8,266,408. The census is by age and sex, but unfortunately for age divisions somewhat at variance with accepted methods.

The economic progress of the country is perhaps revealed most clearly in the governmental revenue and expenditures, the income having increased from 17,334,000 ticals in 1894–95 to 96,066,000 in 1919–20, while the expenditures have increased during the same period from 12,487,000 to 82,560,000 ticals. Among the items of revenue of special interest is the income from opium licenses, given as 2,443,000 ticals in 1894–95 and as 23,222,000 ticals in 1919–20. Among other taxes of special sociological interest is the income derived from the so-called gambling farm, given as from 2,283,000 ticals in 1894–95, reaching a maximum of nearly 7,000,000 ticals in 1904–05, and declining slowly until in 1919–20 the revenue was only 760 ticals, gambling having been abolished first in the provinces and later, as recently as 1918, in the city of Bangkok. Likewise the revenue from the lottery farm, which at the beginning of the period was 1,037,000 ticals, and almost 3,000,000 ticals in 1916–17, ceased entirely in 1919–20.

Encouraging is the increasing expenditures for local sanitary purposes, which in 1904–05 amounted to 1,338,000 ticals, and in 1919–20 to 2,271,000.

The outstanding total national debt of Siam increased from £1,000,000 in 1905–06 to £7,312,560 in 1920–21. The *Year Book* includes also interesting observations on the Siamese Government 4½ per cent Sterling loan of £1,000,000 issued in 1905, of a similar loan of £3,000,000 issued in 1907, and of a loan contracted with the Government of the Federated Malay States for the construction of the Southern Railway, in 1909, of £4,750,000. The finance section also includes an illuminating note on the Gold Standard Reserve Fund, with tables on the exchange operations, by single years, from 1911–12 to 1919–20. This is amplified by a table in detail of exchange quotations for demand drafts on London, Singapore, and Hongkong, by months, from 1902 to 1921; and further by extended tables of the price of bar silver in London from 1900 to 1920. This is followed by a highly interesting note on the currency of Siam, also amplified by extended tables on the number and value in ticals of subsidiary coins imported, held in the central treasury, and in circulation, on March 31, 1921, and covering the period March 31, 1880–81 to 1920–21.

Of special interest is a brief table referring to the progress of savings banks, which in 1916–17 had 1,663,365 ticals on deposit, and by 1920–21 had 2,780,760 ticals.

The working of the state railways is dealt with in full detail for every year since 1897–98, the gross earnings having increased from 232,000 ticals during the first year to over 9,651,000 during 1920–21. The tables in detail contain information regarding the number of passengers carried, the receipts for luggage, the receipts from passenger and freight traffic, and gross earnings per kilometer of line and per 100 train kilometers. There are full details regarding particular items of freight, differentiating goods and livestock, as well as different classes of passengers. The total passenger traffic increased from 276,747 in 1897–98 to over 5,189,400 in 1920–21.

The tables on education are suggestive of the progress which is being made, the number of schools having increased from 391 in 1915–16 to 620 in 1919–20; and the number of scholars, from 29,218 to nearly 50,000 during the same period. These statistics are for government schools only; but aside therefrom in 1919–20 there were 2,355 local schools, with 120,454 additional pupils.

The judicial statistics are admirably condensed and sufficient for ordinary purposes, clearly differentiating the nature of the crimes, by local divisions of the country, for each of the last five years, and summarized for the five-year period. In the entire Kingdom of Siam, among more than nine million people, in the year 1919–20 there were 310 cases of wilful murder, but in addition thereto there were 194 cases of manslaughter. About one-fourth of the crimes were on account of theft, and about one-sixth on account of contravention of gaming laws. The judicial statistics include tables of the number of persons convicted in the First Instance, classified by the nature of the sentences pronounced; also statistics of the work of the Court of Justice of First Instance in civil cases and their disposition.

Under agriculture there are some interesting notes on the registration of mortgages, the number of deeds issued and filed having been 565,454 during the year 1920–21. The registered mortgages are classified according to the nature of the land, the area, the number of holdings, and the value in ticals. Of special interest in this connection are the areas under certain crops, differentiating rice, cotton, tobacco, peas, sesame, pepper, and maize. The most important crop, naturally, is rice, the area of which increased from 13,559,000 rai in 1916–17 to 15,293,135 rai in 1920–21. Cotton growing seems to be increasing, for in 1916–17 the area grown was 29,070 rai against 40,867 in 1920–21. There are additional tables of the number of cocoanut trees, in bearing and not in bearing; the number of elephants, which practically throughout the whole kingdom decrease from year to year, there being in all Siam at the end of 1921 only 6,818 elephants left. The number of buffaloes for the same period was given as 2,603,823.

The opium traffic in the Kingdom of Siam is still of very considerable extent. The opium law of 1920–21 prohibits the smoking of opium except by licensed smokers. Since 1908–09 the control of the sale of opium has been in the hands of the Royal Government. The total value of opium purchased by the Opium Department has increased from 2,116,174 ticals in 1907–08 to 4,064,086 ticals in 1920–21. There are at present 886 retail opium shops in Siam.

The mining statistics are limited to tin, the price of which has almost doubled during the last fifteen years, though declining slightly during the year 1920–21.

The statistics of prices are on the basis of index numbers to reflect the fluctuations in the prices of certain stable commodities. The basic prices are those prevailing in 1914–15, which conforms to modern usage. On this basis the price index number for foodstuffs during 1920–21 was 181; for beverages, 268; and for both combined, 204. The price index number for imported cotton goods increased from 100 in 1914–15 to 276 in 1920–21.

Wages show practically a stationary condition, having undergone but a slight change for ten of the principal employments.

The concluding tables of the report have reference to areas cultivated in rice as graded for revenue purposes.

The book is beautifully printed, on good paper, is of convenient size, and is in every respect a most valuable addition to the growing official literature summarizing the results of governmental operations and inquiries. It must ever be a matter of regret that this admirable precedent set by foreign countries should never have been imitated in a similar manner by even a single American state. The progress of any government, in its final analysis, depends primarily upon a clear grasp of governmental facts, and this is impossible without a condensed statement of the vast bulk of statistical information which is now being gathered by practically every civilized country in the world.

The Ministry of Finance of Siam is setting an admirable example for other nations to follow. The publication of the reports in English makes accessible a wealth of information of which much would otherwise go entirely to waste. The *Year Book* is a useful companion volume to the annual report of the Financial Adviser on the Budget of the Kingdom of Siam, whose report for the year 1920–21 has also recently been issued in the English language.

F. L. Hoffman

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*United States Life Tables 1890, 1901, 1910, 1901–1910,* prepared by James W. Glover. Published by the Bureau of the Census, Washington. 1921. 496 pp.

This volume, which is divided into eight parts, constitutes a complete report on the mortality tables constructed in connection with the census of 1910. The introduction gives a general description of the entire contents of the report and outlines the purposes in view in presenting the report in the particular form adopted.

Part I consists of a non-technical description and explanation of the life table functions, graphs, and other parts of the book. The plan adopted is to give a fairly complete explanation of the various columns contained in the life tables and of the purposes to which they may be put. This is followed by a very extensive set of questions and answers, covering the same ground much more completely and in a way that will be of assistance to many persons because it shows the exact process by which the answers to certain types of questions may be worked out from the mortality tables.

Part II contains the seventy-four life tables which have been constructed in connection with this census investigation. Sixty-four of these tables may be divided into sixteen sets of four each, each set consisting of a table for male lives in 1901, one for males in 1910, one for females in 1901, and one for females in 1910. Seven of the sixteen sets refer to various sections of the population of the original registration states, one set being for the entire population and the others for whites, negroes, native whites, foreign-born whites, whites in the cities, and whites in rural districts respectively. Five of the sets refer to the population of the individual states of Indiana, Massachusetts, Michigan, New Jersey, and New York, and the remaining four sets to the individual cities of Boston, Chicago, New York, and Philadelphia. Of the remaining ten tables, two are for both sexes in the original registration states in 1901 and 1910 respectively; six, based on the experience of the ten years from 1901 to 1910 inclusive, refer respectively to white males, white females, negro males, and negro females, all in the original registration states, and to negro males and negro females in the District of Columbia; and two represent the experience in 1890 on males and females respectively in the state of Massachusetts. Twenty-five of these tables, constituting all of those based on the mortality rates in 1910 except those for the individual cities just mentioned, were shown in the preliminary report on the United States Life Tables which appeared in 1916.

These very extensive sets of tables render possible many comparisons of mortality in different classes of the community, in different localities and at different times, the comparison in the latter respect indicating the steady improvement in mortality at the younger ages, with indications of a slight change to increased mortality at the older ages.

The life tables dated 1901 are based on the estimated population July 1, 1901, and on the reported deaths in 1900, 1901, and 1902. Those dated 1910 are based on the estimated population July 1, 1910, and on the reported deaths in 1909, 1910, and 1911. Those for the ten years 1901 to 1910 inclusive are based on the estimated mean population for the period and on the aggregate reported deaths. Those for the state of Massachusetts in 1890 are based on the estimated population December 1, 1889, and on the reported deaths in the census year ending May 31, 1890.

In Part III life tables are shown for twelve foreign countries in comparison with those for whites in the original registration states for the years 1901 to 1910 inclusive. These comparisons are shown for male and female lives respectively and for five different columns of the life table, the important ones of course being the annual rate of mortality per thousand and the complete expectation of life in years. There are also shown ten mortality tables based on life insurance experience, five of these tables being based on experience in the United States and five on experience in foreign countries. These are compared with the life table for white males in the original registration states in 1910.

Part IV consists of graphs of various functions of the more important of the life tables now constructed, and of the various population tables and of the life insurance tables shown in comparison therewith.

Part V consists of tables of annuity values, single net premiums, annual net premiums, and commutation columns based on the life tables for white males and white females respectively in 1910. The life annuity values and commutation columns are given for interest at 3, $3\frac{1}{2}$, 4, 5 and 6 per cent, and the net premiums for 3, $3\frac{1}{2}$ and 4 per cent.

Parts VI and VII are devoted to an explanation of the processes adopted in the construction of the life tables, part VI covering the mathematical theory and

Part VII giving an actual illustration of the processes followed in the construction of one of the tables. The table selected as a sample was one based on male lives in the state of New York in 1910.

Part VIII contains the original data upon which all of the tables were based.

The selection of this volume most open to critical analysis is obviously Part VI, which deals with the principles adopted. In the main section of the table running for the principal tables from age 5 to the neighborhood of age 80, the rates of mortality were derived from redistributed figures for population and for deaths derived according to Mr. King's method based on osculatory interpolation. This does not call for any further comment here except on the point that the particular quinquennial age periods selected were those commencing with ages ending in 4 and 9. It is to be noted that Mr. Papps in his recent paper on this subject expresses a preference for periods beginning with ages ending in 3 and 8, whereas the method adopted by Mr. King for the English Life Table No. 8 agrees with that adopted for the United States Life Tables.

The rates of mortality at the extreme old ages were derived from the application of Wittstein's formula, the constants being determined from rates of mortality at ten consecutive ages derived according to the method proposed by Mr. King to obtain graduated pivotal values for quinquennial interpolations. These rates of mortality are also used to supply preliminary values for a group of ages just below those to which Wittstein's formula is applied. This whole section of the table is finally graduated by Spencer's 21 term formula, and the rates thus arrived at are used to give a gradual transition from those in the middle section of the table to those derived by Wittstein's formula.

The only criticism which I would make of this part of the processes is that the means adopted to weld the two parts of the table together seem to be rather more elaborate than should be necessary. Perhaps, however, they are more complicated in explanation than in actual application.

Possibly the most interesting part of the explanation is that relating to the adjustment of the population at infantile ages. An examination of the population returns by individual ages indicates very clearly a deficiency of population at the two youngest ages, and a comparison with the birth returns indicates that this is not a transfer to other ages but an absolute failure to report. Some method was therefore necessary to estimate the true population at these ages. The method described in this volume may be summarized as an estimate of the population at ages 2 to 5 two years after the close of the period of observation, or three and one-half years after the middle of that period, combined with an analysis of the death returns of the period of observation and the succeeding two calendar years so as to determine, approximately at least, how many of these deaths should be assigned to those born during the three calendar years of observation. It was then assumed that immigration could be ignored at these ages and that the number of births during the period of observation would be obtained by adding these deaths to the estimated survivors two years after the end of the period, their ages being then between 2 and 5 years.

An estimate was then made of the increase in the population at each individual age during the three years, and by successively subtracting from the number of births these increases and the deaths and making the proper adjustment, the number exposed to risk was obtained for the individual ages. The exposed to risk thus obtained was used for all ages up to four, last birthday inclusive.

It will be noted that these recalculated exposures were used for ages 2, 3, and 4 last birthday, although statistics were available for the population at those ages which were considered as correct, at least in the aggregate, and were used as the basis of the estimate. This suggests a comparison between the average population at these ages as derived from the recalculated exposed risk and the original statistics. This comparison for male lives in the state of New York is shown below, together with other redistributions of the population which will be referred to later.

It will be noted that the total population at these three ages according to the official adjustment is 2,601 less than the total population at the same ages according to the original statistics, which fact indicates an average increase of nearly 1 per cent in the rate of mortality at these ages and suggests the idea that possibly more satisfactory results would have been obtained by substituting for the method actually used in estimating the births during the period one based on the idea of so determining these births that after the rest of the process had been followed through, the total of the population at ages 2 to 5 would agree with the original statistics. It is easy to see that this correction would amount to adding 2,601 to the estimated births during the period and consequently to the exposed to risk at each subsequent age. This would amount to adding 867 to the average population at each age and would give the figures contained in the foregoing table under the heading "First correction." This adjustment although probably sufficiently satisfactory for all practical purposes is still liable to the criticism that although the population according to the original statistics for ages 0 to 1 last birthday is deficient, it is used as the basis for the estimate of the increase in population at those ages during the period of observation, and that while we have considered the population of the ages between 2 and 5 as subject to redistribution, varying percentages of increase are used for these ages determined from the original statistics. This objection could be obviated by using a uniform percentage under 5, based on the combined statistics for ages between 2 and 5 and deriving a recurrence formula based on the principle that the increase in population at each age bears a fixed ratio to the finally adjusted population rather than to the original statistics. The figures for the population given in the above table under the heading "Second correction" are derived according

AVERAGE POPULATION

| Ages | Original statistics | Official adjustment | First correction | Second correction |
|---|---|---|---|---|
| 2–3 | 94,229 | 92,372 | 93,239 | 93,186 |
| 3–4 | 90,718 | 89,476 | 90,343 | 90,454 |
| 4–5 | 86,876 | 87,374 | 88,241 | 88,183 |
| | 271,823 | 269,222 | 271,823 | 271,823 |

to this method, and the following table gives the rates of mortality at ages 0 to 4 inclusive according to the original statistics unadjusted and according to the various adjustments above referred to.

MALE LIVES IN THE STATE OF NEW YORK

Rates of Mortality per 1000

| Age | Unadjusted | Official | First correction | Second correction |
|---|---|---|---|---|
| 0 | 135.31 | 127.13 | 126.18 | 126.38 |
| 1 | 37.32 | 33.64 | 33.35 | 33.37 |
| 2 | 15.25 | 15.56 | 15.42 | 15.42 |
| 3 | 9.18 | 9.31 | 9.22 | 9.20 |
| 4 | 6.59 | 6.55 | 6.49 | 6.49 |

An investigation of the reason for the deficiency in population, disclosed by the official readjustment, indicates that this is principally due to the use of actual death returns for the years 1912 and 1913, which not only did not increase in proportion to the estimated increased population but actually decreased. The actual deaths added in arriving at the assumed births according to the official adjustment were 57,529, and the corresponding deaths during the three years 1909 to 1911 inclusive were 58,926, showing a decrease of 1,397 instead of the expected increase.

The whole volume forms a very valuable addition to our records regarding mortality experience, and it is well worth the study of those interested in the subjects covered by it.

Robert Henderson

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*Introduction to Economic Statistics*, by George R. Davies. New York; The Century Company. 1922. vi, 163 pp.

The economist who would employ quantitative methods in attacking his problems is enabled to do so largely because of contributions made by workers in other fields. Methods of dealing with assembled measurements and with mass phenomena which have been developed by the biometrician, the demographer, the astronomer, the mathematician, the logician, have been taken over by the economist. Though many economists—Jevons, Edgeworth, Moore—have contributed to the development of the science, statistics is to economics an adopted child or, to change the figure, an alien who must be naturalized. The methods of the biometrician cannot be employed unchanged by the economist. Adaptations must be made, new devices employed, and tests made of the validity of old methods when applied to the raw materials of economics. All this is being done. Methods borrowed from Quetelet, Galton, Pearson, and the other fathers of modern statistics are being welded into a body of method designed for handling the data of economics. This by no means involves the building up of a new science of statistics, but merely modification and adaptation, with the central core of the science unchanged.

The fact that the science of statistics is largely of alien birth has been something of a barrier to the adoption of quantitative methods in economics. The subject has been expounded, to a great extent, in terms of anthropometry, demography, education. Leaves, nuts, clam-shells, and cricket batting averages have bulked large in textbook and classroom. The terminology—lines of regression, probable error—bears the imprint of an alien origin. The economist is deeply indebted to those from whom quantitative methods have been borrowed, but the need has been pressing for the presentation of statistical methods in a form better adapted to his immediate needs, with dress and mannerisms which will not evoke the suspicion which adheres to strange ways. Within the last few years several books have appeared in this country which help to meet this need. The book at present under review is the most recent of these publications.

Within the 132 pages of text there is treatment of the subjects of tabulation, types and measures of dispersion, price, wage and quantity index numbers, trends and cycles, and correlation, with an appendix dealing with the laboratory material required for ordinary statistical and graphic work. A set of very useful laboratory exercises follows each of the six chapters. In the sections on index numbers and on trends and cycles the writer is dealing with subjects in which the economist and business statistician are vitally interested, and which have not been covered adequately in most of the standard works on statistics. The methods of analyzing and comparing time series discussed in these chapters rest in part upon recent work by the author and other statisticians, and this explanation constitutes a welcome addition to existing material. The exposition is concise and lucid throughout. Illustrative examples are numerous and well-chosen.

Condensed and clear as the treatment is, the author fails to cover completely the field marked out by his six chapter headings. The treatment of the fundamentals of statistical method is inadequate, if the book is to stand by itself as an exposition of the subject. One whose knowledge of statistics was based upon this book alone would have an acquaintance with certain methods, but an incomplete understanding of the basic reasoning and the assumptions lying back of these methods. It is not only that underlying hypotheses are undeveloped: the explanation of the statistical measures and methods dealt with in the book is in some cases too condensed for the beginner, for whom the book is avowedly written. It is inevitable that this should be so in such a brief treatment, and the author undoubtedly recognizes this limitation. When supported by classroom explanation and laboratory work these difficulties would not be experienced, and it is from such a situation that the book developed. (The book is an outgrowth of an undergraduate course in statistics given at Princeton University during the academic year 1920–21.) But when it stands alone these inadequacies would be felt, and consultation of other books, to which the reader is introduced by numerous references, would be necessary.

But these criticisms are perhaps ungracious. Here is a useful contribution, a well-written presentation of the statistical methods which the economist must employ, prepared with the needs of the economist in mind. The alien atmosphere of mortality statistics, cephalic indexes, and lobster lengths has been dissipated. All who are interested in economic study must be grateful for the impetus which is given by such works as this to the development of quantitative methods of research in the field of economics, to the collection and analysis of hard facts in studying the working of the business system.

Frederick C. Mills
Columbia University

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*The Clothing Workers of Chicago*, 1910–1922, by Leo Wolman, Eleanor Mack, H. K. Herwitz, and Paul Wander, Chicago: The Chicago Joint Board, Amalgamated Clothing Workers of America, 1922. 424 pp.

There is an ideal economic world, now forsaken by most economists but still assiduously preached by newspaper editorial writers, in which immutable laws operate with automatic precision to defeat the human will, especially when the will is expressed in group action. In that world wages and prices are fixed solely by competitive forces under the conditions of demand and supply. Labor, capital, land, and the entrepreneur each receive what they respectively contribute to production—no less and no more. There are unalterable relations between prices and wages: when wages go up, the wage-earners are inevitably defeated by corresponding rises in prices, and when prices go down, wages must be equally "deflated." In that world, labor organization, in so far as it attempts to wield economic power, is both useless and pernicious. The necessary exponent of economic law is the individual employer; through him, as through a king enthroned in divine right, Destiny is made manifest. The Open Shop, regulated by the Efficiency Engineer, is the loyal and happy kingdom.

Most exponents of this doctrine hold the delusion that the ideal is real. They exhort people to be resigned and not to kick against the pricks. But people insist on kicking. The reality is full of unions and strikes. Industrial potentates are defied; their powers are limited by forces other than economic law. All this goes on in prosperity and in depression, despite exhortation.

*The Clothing Workers of Chicago, 1910–1922*, is significant because it is a careful picture, not of the ideal world of automatic economics, but of a part of the real world in which the organized wage-earners have fought their way to recognition and have succeeded in expressing a collective will in an industry. Here the dogma of divine right has been frankly abandoned, and the democratic experiment of collective regulation has won its preliminary fight for life and been given a chance to try what it can do through constitutional government.

In the beginning the clothing industry was a paradise according to the theory of free competition. No industry was more competitive, none was less subject to any regulation outside of "economic law." The result was not a paradise for the workers. It was embodied in the sweatshop, in starvation wages, in unlimited hours of work at some periods of the year and unemployment at others. The workers rebelled. The early history of that rebellion shows all the marks of the type of industrial conflict now going on in many other industries, which is ordinarily assumed to be futile. It includes bitter and lost strikes, short-sighted union policy, even grafting union officials. It includes injunctions, defiance from self-righteous employers, "radicalism," and all the rest. But eventually the workers won a foothold in the shop of Hart, Schaffner and Marx, and the machinery of government began to develop. It now embraces the whole of the Chicago market, with its 40,000 to 50,000 employees, and has brought comparative industrial peace—as well as higher wages, shorter hours, and better conditions throughout.

This history of the union's struggle for recognition, and of the subsequent development of constitutional government in industry, prepared under the direction of Mr. Leo Wolman with the coöperation of Miss Eleanor Mack, Mr. H. K. Herwitz and Mr. Paul Wander, gives an impressive picture of collective action which cannot be ignored by students of economics. It explains, in the first place, how the collective economic power of the workers brought about a system of adjustment having two main features: First, a machinery of general arbitration, and second, a machinery for the application of general principles to specific cases through a Trade Board and an Impartial Chairman. It explains the structure of the union, showing how it furnishes the cohesive force in the industry through the Joint Board and the subordinate shop chairmen. Perhaps the most important of all, however, is the section devoted to an analysis of the decisions and precedents arrived at in the operation of this industrial government in important matters such as the powers of management, discipline and discharge, the introduction of new processes and machinery, the adjustment of wages, and the principle of union preference (an issue usually inaccurately stated in terms of the "open" *vs.* the "closed" shop).

The book should be sharply differentiated from the many current treatises which approach the "labor problem" from the point of view of a type of management which may allay or prevent open discontent, or from the point of view of arbitration or adjustment imposed from above chiefly with a view to protecting "the public" from inconvenience or loss. It is an invaluable study, not of a patent scheme, but of a genuine social and economic development in industry arising chiefly from the workers themselves.

George Soule

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*Annual Report on the Demography and Public Health of Brussels for the Year 1920.*

This admirable publication reflects throughout with characteristic Belgian thoroughness the gratifying tendency of that nation toward the road of social and economic recovery. The enumerated population of Brussels as of January 1, 1920, is given as 156,924, of which 71,134 were males and 85,790 were females. Of the total population only 62 were 90 years of age or over, while the proportion at ages under 1 was 1.32 per cent. The density of population for the city of Brussels is 146 per hectare, but it runs as high as 432 for the second territorial division of the city. The birth rate for the year 1920 was 17.9 per 1,000, which is a gratifying increase over the average for 1911–19, given as 13.4, but it is far below the average for the period 1867–70, when the rate was as high as 38.8. The statistics of illegitimacy indicate a lamentable moral condition, the percentage of illegitimate births for 1920 having been 24.0, which, however, is somewhat less than the average for 1911–19, given as 28.0. Equally disturbing is the high number of divorces, which is given as 171 for the year 1920, which compares with an average of 114 for the period 1911–19.

The death rate during 1920 was 13.0 per 1,000, which contrasts with a death rate of 29.8 during 1867–70 and 16.7 during 1911–15. Contagious diseases have diminished very materially during recent years, including the war period, the rate having declined from 4.4 per 1,000 in 1867–70 to 0.7 in 1901–10, 0.4 during 1911–15, 0.3 during 1916–19, and only 0.2 during 1920.

There was an astonishing decline in the mortality from pulmonary tuberculosis, the lowest figure on record having been reached during 1920, when the rate was only 9.7 per 10,000, in contrast to a rate of 49.4 during 1867–70. During the early war period the rate was 16.2, and during the later period, 23.8 per 10,000 of population.

In contrast, there was a very slight increase in the mortality from cancer in 1920 as compared with 1919, the rate for the later year being lower than during any previous year except 1914 and 1916.

The actual deaths from pulmonary tuberculosis decreased from 267 during 1919 to 152 during 1920. Among other interesting facts disclosed by the table of causes in detail reference may be made to the mortality from suicide, which during 1920 decreased to 39 as against 45 in 1919; and there were only two deaths from homicide during 1920 in a population, as previously stated, of 156,924. During the previous year the number of deaths from homicide was 4. There was only one death from typhoid fever, five from smallpox, two from scarlet fever, and ten from whooping cough.

These observations apply exclusively to the city of Brussels and have no reference to the suburbs, the population of which increases the number of inhabitants of Greater Brussels to 811,690. For this area the death rate during 1920 was 13.3, while the birth rate was 17.4, or about the same as for the city of Brussels in the more restricted sense of the term. The report is illustrated by a number of admirable diagrams and maps.

F. L. Hoffman

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*The Mathematical Theory of Probabilities and Its Application to Frequency Curves and Statistical Methods*, by Arne Fisher. *Volume I. Mathematical Probabilities, Frequency Curves, Homograde and Heterograde Statistics.* 2d. ed., greatly enlarged. New York: The Macmillan Company. 1922. xxix, 289 pp.

The enlargement of the second edition of this volume consists in adding to the 171 pages of the old edition, which now appears as Part I, two new sections: Part II, pp. 169–214, on Frequency Curves and Heterograde Statistics, and Part III, pp. 215–89, on Practical Applications of the Theory. It is therefore practicable to let the earlier review[1] stand as written and turn attention to the additions.

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[1] This Journal, Vol. VI, Dec. 1916, pp. 468–9.

In Part II there are two chapters: XIII, The Theory of Errors and Frequency Curves and Its Application to Statistical Series. General Remarks, p. 169; XIV, The Mathematical Theory of Frequency Curves, p. 188. In Part III are four chapters: XV, The Numerical Determination of the Parameters, p. 215; XVI, Logarithmically Transformed Frequency Functions, p. 235; XVII, Frequency Curves and their Relation to the Bernoullian Series, p. 261; XVIII, Poisson-Charlier Frequency Curves for Integral Variates, p. 271. These titles indicate in a fairly clear manner the contents of those new sections of the volume which follow and depend upon the general theory of probabilities. Parts II and III are not only more advanced, they are decidedly harder reading than Part I. The reader who is unfamiliar with mathematics will find little cheer. A well-known quotation comes to mind: Je me rends parfaitement compte du désagréable effet que produit sur la majorité de l'humanité, tout ce qui se rapporte, même au plus faible dégré, à des calculs on raisonnements mathématiques. Still, there is a point beyond which one cannot go in statistics unless he is able to overcome his dislike for mathematical analysis or at least for mathematical reasoning.

In this book Mr. Fisher shows that he belongs to the school of Laplace, Poisson, Gram, Charlier—the French-Scandinavian school rather than the German or the English. This is fortunate, for it brings into our scientific literature a presentation of ideas hitherto almost if not quite lacking in it. We are promised by Mr. Fisher a continuing volume which will be eagerly awaited, particularly as it will contain not only additional statistical theory and application but mathematical tables advantageous to those who would apply the theory already incorporated in the new Volume I.

Edwin Bidwell Wilson

Harvard School of Public Health

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